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DEPARTMENT OF THE INTERIOR
BUREAU OF EDUCATION

BULLETIN, 1917, NO. 22

THE MONEY VALUE OF EDUCATION

By A. CASWELL ELLIS
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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
BUREAU OF EDUCATION,
Washington, February 15, 1917.

SIR: All admit the value of the education of the schools for general culture and esthetic appreciation and as a preparation for citizenship in a democracy, and most are willing to contribute out of the public funds to the support of the schools for these ends when they feel that the people are able to do so without too much sacrifice of what they call the necessities of life and too heavy a drain on their material prosperity. Comparatively few are aware of the close relation between education and the production of wealth, and probably fewer still understand fully the extent to which the wealth and the wealth-producing power of any people depend on the quantity and quality of education. The people themselves and their representatives in tax-levying bodies need to be shown that no other form of investment yields so large dividends in material wealth as do investments in popular education, and that comparative poverty is not to be pleaded as a reason for withholding the means of education, but rather as a reason for supplying them in larger proportion. To assist in this I recommend that the manuscript herewith transmitted be published as a bulletin of the Bureau of Education. The manuscript has been prepared at my request by Dr. A. Caswell Ellis, professor of the philosophy of education in the University of Texas. It is my purpose to transmit later, also for publication as a bulletin of this bureau, a manuscript by Dr. Ellis showing more specifically the direct and indirect relation of higher education to the production of wealth and to industrial development.

Respectfully submitted.

P. P. CLAXTON,
Commissioner.

The SECRETARY OF THE INTERIOR.

THE MONEY VALUE OF EDUCATION.

The most valuable result of right education is the broadening, deepening, and refining of human life. This result can no more be measured by dollars and cents than truth, self-sacrifice, and love can be made out of pork and potatoes. While the higher things of the soul are priceless rewards which true education brings, they are not its only result. The material and measurable rewards of education should be made plain to those whose votes must determine the support of our educational system. Those who desire better support of that system should point out in terms that the people can understand the definite ways in which education promotes industrial efficiency and increases material wealth. That is the purpose of this bulletin.

NATIONAL WEALTH AND POWER DETERMINED BY EDUCATION.

Germany.—The concrete evidence of the effect of education in increasing industrial efficiency is overwhelming, whether considered from the national standpoint or from that of the individual citizen. For example, how else account for the fact that a nation like Germany, with limited natural resources, but with excellent public schools, has grown in wealth and power so much more rapidly than her neighbor, Russia, which has a vigorous and talented national stock and vastly better resources but poor educational facilities? That the phenomenal success of Germany is the direct result of her thorough educational system is generally admitted.

John A. Lapp says:[1]

> Germany, as a result of industrial training, already puts four times as much labor value into its manufactured articles as the United States. If this country merely equaled Germany's present record, we (the United States) would be manufacturing from the same raw products not $20,000,000,000, but $80,000,000,000 worth of finished articles.

President Vanderlip, of the National City Bank of New York, said:

> In the group of great industrial nations there has come forward in recent years one that has taken a place in the very front rank among industrial competitors. That nation is Germany. Her people have lacked the peculiar

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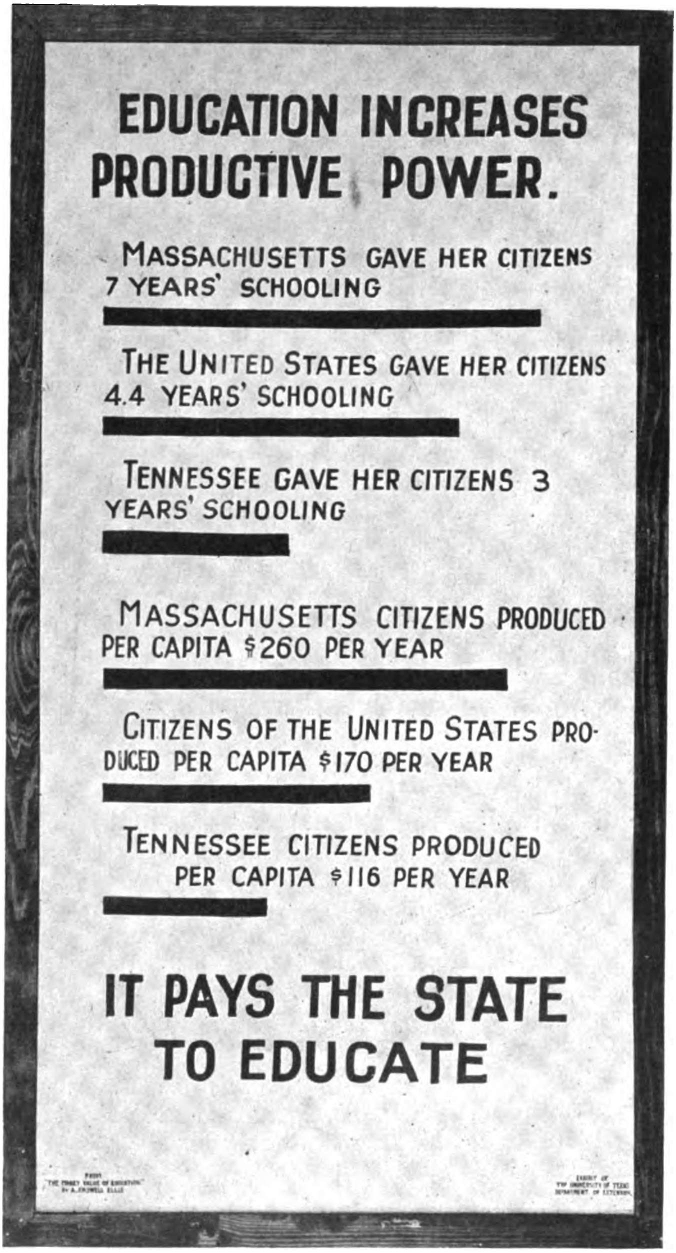
[1] "Case and Comment," Sept., 1913, p. 234.



EDUCATION INCREASES PRODUCTIVE POWER.

MASSACHUSETTS GAVE HER CITIZENS 7 YEARS' SCHOOLING

THE UNITED STATES GAVE HER CITIZENS 4.4 YEARS' SCHOOLING

TENNESSEE GAVE HER CITIZENS 3 YEARS' SCHOOLING

MASSACHUSETTS CITIZENS PRODUCED PER CAPITA $260 PER YEAR

CITIZENS OF THE UNITED STATES PRODUCED PER CAPITA $170 PER YEAR

TENNESSEE CITIZENS PRODUCED PER CAPITA $116 PER YEAR

IT PAYS THE STATE TO EDUCATE

FIG. 1.

The figures in this chart are from "A World-Wide Law," by Charles W. Dabney, and are for 1899. The figures would be much higher for all in 1909, but the relative standing of each would be the same. The production for 1909, as estimated from the figures given by the 1910 census, would be: Massachusetts $466, the United States as a whole $332, Tennessee $174.

> inventive ingenuity which in many fields of industry has been the sole basis of our achievements. Her artisans have almost none of the delicate sense which makes the French handiwork superior to the obstructions of all tariff walls. But amidst this poverty of natural resources, and from among a people not signally gifted with inventive ability or artistic temperament, there has in a generation emerged an industrial nation which stands forth as a marvel of economic development.
>
> I have had a somewhat unusual opportunity to study the underlying causes of the economic success of Germany, and I am firmly convinced that the explanation of that progress can be encompassed in a single word, the "schoolmaster." He is the great cornerstone of Germany's remarkable industrial success. From the economic point of view the school system of Germany stands unparalleled.

Japan and Russia.—Similarly the relation of her school system to the remarkable development of Japan and her proved ability in the highly technical and complicated art of modern warfare is universally admitted. The defeated Kuropatkin states that the costly failures of Russia were due to the ignorance of her brave but untutored army and to the education of the Japanese. Writing of the causes of defeat, he said:

> The noncommissioned officers in the Japanese army were much superior to ours, on account of the better education and greater intellectual development of the Japanese common people. The defects of our soldiers—both regulars and reservists—were the defects of the population as a whole. The peasants were imperfectly developed intellectually, and they made soldiers who had the same failing. The intellectual backwardness of our soldiers was a great disadvantage to us, because war now requires far more intelligence and initiative, on the part of the soldier, than ever before. Our men fought heroically in compact masses, or in fairly close formation, but if deprived of their officers they were more likely to fall back than to advance. In the mass we had immense strength, but few of our soldiers were capable of fighting intelligently as individuals. In this respect the Japanese were much superior to us. * * * Among many of the common soldiers whom we took as prisoners we found diaries which showed not only good education but knowledge of what was happening and intelligent comprehension of the military problems to be solved.

The United States and other countries.—The remarkable results in these instances can not be attributed to racial or climatic differences, for in like manner, in Denmark, in Scotland, in Switzerland, in Massachusetts, wherever there is adequate provision for education, there follow great industrial efficiency and national wealth.

On the other hand, in Spain, in Russia, in Turkey, in Mexico, wherever there is a lack of the necessary school system, there is the same story of poverty, revolution, and misery, regardless of race, climate, or abundance of natural resources. Even in the United States it has been shown that the earning capacities of the citizens of several States are in direct proportion to the efficiency of their school systems. Dr. Charles W. Dabney, who investigated this matter, found, for example, that the average schooling given in 1898–99 to the citizens of Massachusetts was 7 years; to those of the United States as a whole, 4.4 years, while that of Tennessee was only 3 years. Corresponding to these figures, he found that the average daily production of the citizen of Massachusetts was 85 cents; that of the United States as a whole was 55 cents; while that of Tennessee was only 38 cents.[1]

Mr. Dabney does not tell how he determined the productive capacity of the citizens of these States, but by taking the sum of the combined products of farms, factories, mines, and quarries, as given for each State in the 1910 report of the Census Bureau, and dividing by the population of the State, a very rough approximation of the average earning power of the inhabitants may be secured. When this is done, it shows a productive capacity for 1910 for Massachusetts of $466 per year; for the United States as a whole, of $332; and for Tennessee, of $174.

Massachusetts spent in 1898–99 on her schools $12,261,525 more than Tennessee, which spent only $1,628,313, or $4.62 per pupil, against $38.55 per pupil spent in Massachusetts. But Massachusetts showed a productive capacity of $144 more per year per inhabitant than did Tennessee, and $90 a year more than the average for the United States. In total, Massachusetts put about thirteen millions per year more than Tennessee into her schools and received nearly four hundred million dollars annually in increased earning capacity, in large measure produced by the education of its citizens. Similar studies made by the late United States Commissioner of Education, William T. Harris, and Mr. Wadlin, former chief of the Massachusetts Bureau of Labor Statistics, showed practically the same results.

It would, of course, be very unfair to attribute all this difference in productive capacity to differences in the educational systems of the several States. The large capital on hand, the great trading centers and the numerous factories already established in Massachusetts give that State an advantage. Furthermore, the effect of climate, and many other factors, must be considered before the exact share played by education could be determined. In this and in all other comparative studies of peoples, it must be recognized that absolutely accurate estimates of the part played by education in economic development are not possible. Yet the unbiased observer must recognize that education is a controlling factor when he sees that among all varieties of races, and accompanied by all kinds of conditions of climate, natural resources, geographical location, economic and social environment, in every case educated people produce much and amass wealth, while uneducated people under the same conditions produce little and save less.

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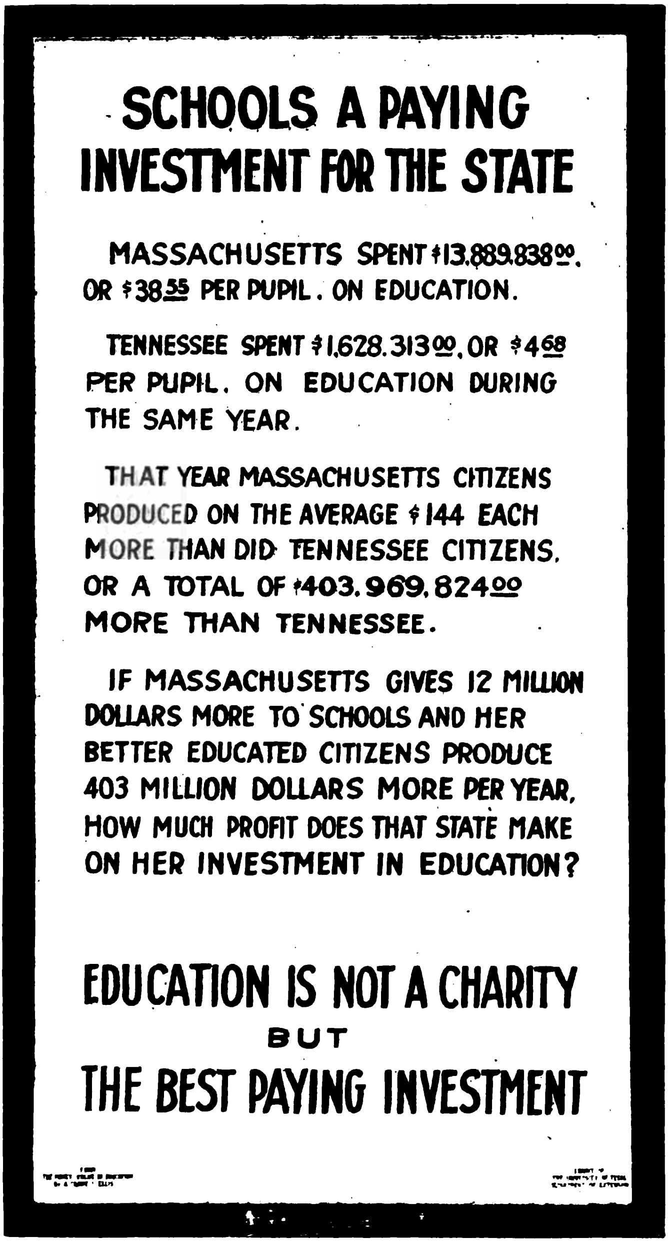
[1] World's Work, I, 587–88, Apr., 1901; and "A World Wide Law," the University of Tennessee Index, Ser. II, No. 10.



SCHOOLS A PAYING INVESTMENT FOR THE STATE

MASSACHUSETTS SPENT \$13.889.838^{00}. OR \$38^{55} PER PUPIL. ON EDUCATION.

TENNESSEE SPENT \$1.628.313^{00}. OR \$4^{68} PER PUPIL. ON EDUCATION DURING THE SAME YEAR.

THAT YEAR MASSACHUSETTS CITIZENS PRODUCED ON THE AVERAGE \$144 EACH MORE THAN DID TENNESSEE CITIZENS. OR A TOTAL OF \$403.969.824^{00} MORE THAN TENNESSEE.

IF MASSACHUSETTS GIVES 12 MILLION DOLLARS MORE TO SCHOOLS AND HER BETTER EDUCATED CITIZENS PRODUCE 403 MILLION DOLLARS MORE PER YEAR, HOW MUCH PROFIT DOES THAT STATE MAKE ON HER INVESTMENT IN EDUCATION?

EDUCATION IS NOT A CHARITY

BUT

THE BEST PAYING INVESTMENT

FIG. 2.

The figures are from "A World-Wide Law," by Charles W. Dabney, and are for 1899. The figures for 1909 show the same facts. Estimates based on the total productions recorded in the 1910 census reports show a per capita production for Massachusetts of \$466, for Tennessee of \$174, and for the United States as a whole \$332.

Other concrete illustrations of this fact are at hand. For example, Mullhall[1] gives the annual earning capacity of the inhabitants of several European countries as follows:

Nations with efficient educational systems.		Nations with inadequate educational systems.	
England	£36	Spain	£16
France	31	Greece	13
Germany	25	Russia	10

The effect of education upon the accumulation of wealth is equally notable. The figures given by Mullhall for the total wealth per inhabitant of these several European nations are:

Nations with efficient educational systems.		Nations with inadequate educational systems.	
England	£302	Spain	£135
France	252	Greece	101
Germany	156	Russia	61

Similarly, in America, Massachusetts, with slightly smaller population than Texas, has $4,956,000,000 of accumulated wealth to $2,836,000,000 possessed by Texas.[2] That this is not altogether due to the fact that Massachusetts is a much older State than Texas is shown by the fact that Wisconsin, a comparatively new State, with only about two-thirds the population of Texas, has an equal amount of wealth; and California, a newer State, with only two-thirds the population, has $4,115,000,000 of wealth. All three of these richer States for years spent two or three times as much per child on education as Texas spent.

The relation of productive power to education is shown by the enormously increased rate of production that has come about everywhere since education became more generally diffused. The total wealth accumulated in America from 1492 to 1860, a period of 368 years, was $514 per capita. From then till 1904, a period of only 44 years, this increased to $1,318 per capita, or an addition in 44 years of $802 per capita.[3] Since that time the increase has been even more striking. This increase is partly due to increased valuations or the smaller purchasing power of the dollar; to the use of accumulated capital, and to many other things; but after due allowance is made for all these the conclusion is inevitable that the education of the Nation is largely responsible for vastly increasing the productive power of its citizens. The productive power of illiterate countries is not increasing at such rates.

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[1] Industries and Wealth of Nations, pp. 391 and 393, published in 1896.

[2] All figures are from the Special Report of the Census Office on Wealth, Debt and Taxation, 1907, p. 37.

[3] Figures from the Special Report of the Census Bureau on Wealth, Debt, and Taxation, 1907, p. 9.

Why educated nations produce more.—That there must be this intimate relation between education and earning power is obvious as soon as consideration is given to the demands of the processes of modern industry. The Asiatic farmer, with his stick plow, makes 6 cents a day,[1] and the illiterate Russian peasant with his primitive implements and methods earns 14 cents, while the American farmer earns many times these sums because his improved methods and implements, made possible by education, have increased his efficiency. The illiterate race is necessarily restricted to the bullock and the stick plow, while the educated nation mines and smelts ores, manufactures the reaper and the traction engine, fertilizes the soil, rotates crops, breeds better stock and better seeds by scientific methods, rises superior to flood, drought, and disease, and multiplies efficiency a hundredfold.

Natural resources worthless without education.—Even a bounteous harvest in a fertile section would avail little for an illiterate people who could not build the engines or boats to transport it, or understand the processes necessary for its preservation against a future day of want. Without the knowledge of chemistry and metallurgy, rich mineral deposits are but so much worthless rock. Without tools and machinery and educated skill to turn them into houses, furniture, and implements for man, vast timber resources are but so many trees cumbering the soil; without educated brain and skilled hands the fertile soil, timbered land, water power, and mineral deposit must forever lie idle or be ignorantly squandered.

Comparison of illiterate and educated workers.—Horace Mann vividly pictures the power of education in his statement about the savage and transportation. Modifying his statement, it can be said: The savage can fasten only a dozen pounds on his back and swim the river. When he is educated enough to make an axe, fell a tree, and build a raft, he can carry many times a dozen pounds. As soon as he learns to rip logs into boards and build a boat, he multiplies his power a hundredfold; and when to this he adds mathematics, chemistry, physics, and other modern sciences he can produce the monster steel leviathans that defy wind, storm, and distance, and bear to the uttermost parts of the earth burdens a millionfold greater than the uneducated savage could carry across the narrow river.

---

[1] Report on taxation, Proceedings and Addresses, Nat. Educ. Assoc., July, 1905, pp. 27–28:

"In India only 5 per cent can read and write, and there the men receive for farm work, in the Madras district, 6 to 8 cents a day; women, 4 to 6 cents; children, 3 to 5, the laborers boarding themselves" (pp. 6 and 16).

"If Asia had a Panama Canal to dig, she would dig it with picks, hoes, and spades, and tote out the earth in buckets. Nothing but human bone and sinew would be employed, and the men would be paid little, because without tools and knowledge they must always earn little. But America puts brains, science, steam, electricity, machinery into her Big Ditch—tools and knowledge, in other words, and she pays good wages because a man thus equipped does the work of 10 men whose only force is the force of muscle."—"Asia's Greatest Lesson for the South," Clarence H. Poe, pp. 10–11.

The efficiency of an illiterate people in competition with an educated nation is as the crooked stick against the sulky plow; the sickle against the reaper; the bullock cart against the express train, the ocean greyhound, and the aeroplane; the pony messenger against the telegraph, telephone, and wireless; the individual harangue against the printing press, the newspaper, the library; the spinning wheel against the factory; the pine fagot against the electric light; the peddling of skins and herbs from the oxcart against the bank, the check book, the railroad, the department store; the log hut against the steel skyscraper; the unaided eye against the microscope and telescope; incantations and magic against the chemist, the hospital, the modern physician and surgeon. Take away from one entire generation all education, and society must revert to the stick plow, the oxcart, and such primitive means, because steel implements, locomotives, steamships, electricity, telephones, telegraph, waterworks, steel buildings, mining and chemical industries, factories, modern sanitation, hygiene and medicine, books, newspapers, courts of justice, and laws that protect property and defend the rights of the weak are all impossible without education and are efficient only in proportion as educated intelligence is applied to them.[1]

The necessity for education rapidly increasing.—The necessity for education has increased and will continue to increase with the advance in the complexity of the processes of civilization. Because of the unparalleled progress in the arts and sciences during the past fifty years the need for education has in a generation multiplied many fold. For example, a century ago a transportation system was little more than a wagon and a driver who knew the road. Now, in handling a problem of transportation, experts in traffic must first determine whether a road in that place will be worth while, and what kind of road will be most economical and efficient; experts in finance must provide the tremendous sums needed to build the road; civil engineers must lay it out; bridge engineers plan the bridges; chemical engineers test the materials; mills and factories with scores of chemical and physical experts make the rails, build the locomotives and steel cars; and a host of traffic experts, auditors, accountants, and specially trained managers and clerks, telegraphers, engineers, conductors, and others keep the trains moving with safety and with profit. In like manner the farmer can no longer merely exhaust one fertile piece of fresh soil after another by crude methods of agriculture. Intelligent rotation must be planned, soil must be conserved and built up, improved stock and seed must be bred; methods of cultivation that stimulate growth and conserve moisture and fertility must be practiced; markets must be studied and considered in planting; new methods of marketing must be used, accounts must be kept, and homes must be made healthful. If this is not done the landowner will soon lose his land and become a tenant and the tenant become a day laborer. In law, in medicine, in teaching, in manufacturing, in trade and industry of all kinds, this same increased demand for education is found.

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[1] The advantage to each of the education of all is admirably brought out in the following paragraph from Mr. Clarence Poe: "You prosper just in proportion to the prosperity of the average man with whom you are brought into business contact. If the masses of the people are poor and ignorant, every individual, every interest, every industry in the community will feel and register the pulling-down power of their backwardness as inevitably as the thermometer records the temperature of the air. The merchant will have poorer trade, the doctor and lawyer smaller fees, the railroad diminished traffic, the banks smaller deposits, the preacher and teacher smaller salaries, and so on. Every man who through ignorance, lack of training, or by reason of any other hindering cause, is producing or earning only half as much as he ought, by his inefficiency is making everybody else in the community poorer."—"Asia's Greatest Lesson for the South," Clarence H. Poe, pp. 3–4.

A banker's opinion.—Speaking in 1905 at Girard College, Mr. Vanderlip said:

> The mental equipment of a business man needs to be greater to-day than was ever before necessary. Just as the sphere of the business man's actions has broadened with the advent of rapid transportation, telegraphs, cables, and telephones, so have the needs of broad understanding of sound principles increased. It was steam processes of transportation and production that really made technical education necessary. The electric dynamo created the demand for educated electrical engineers. So the railroad, the fast steamship, the electric current in the telephone and cable, and the great economic fact of gigantic and far-reaching business combinations are making the science of business a different thing from any conception of commerce which could have been had when Girard was the most successful of business men. The enlarged scope of business is demanding better trained men, who understand principles. New forces have made large scale production, and we need men who can comprehend the relation of that production in the world of markets. There has been introduced such complexity into modern business and such a high degree of specialization that the young man who begins without the foundation of an exceptional training is in danger of remaining a mere clerk or bookkeeper. Commercial and industrial affairs are conducted on so large a scale that the neophyte has little chance to learn broadly, either by observation or experience. He is put at a single task; the more expert he becomes at it the more likely it is that he will be kept at it, unless he has had a training in his youth which has fitted him to comprehend in some measure the relation of his task to those which others are doing.

Business growing more complicated.—An excellent illustration of the manner in which modern business has widened the scope of its demands for training and broad education is given by J. T. Young in speaking of several modern industries:[1]

> The production of oil has led to an especially interesting series of auxiliary enterprises. Crude and refined oil, petroleum jelly, gas, gasoline, and light oils, fine and heavy lubrication oils, wax, paraffin, chewing gum, oil cake,

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[1] Annals Amer. Acad. Pol. and Soc. Sci. 28, pp. 28–37, "Business and Science," by J. T. Young.

barrels, tin cans, bags, and wooden boxes are all manufactured in the various departments and plants of the industry. In addition, it has proved profitable to own and operate banks, steamship lines, and various other commercial undertakings.

In gas manufacture, tar, briquettes, light oils, dyes, creosote, and coke are resultant by-products leading to the development of new markets and new departments of business. The most successful meat-packing concerns have been directed by men who are able to develop extensive "allied" industries. Besides the usual dressed fresh, canned, dried, and smoked meats, the packing interests manufacture soups, meat extracts, sausage, lard, toilet, laundry, and wool soap, gelatin, pepsin, glue, fertilizer, etc., and operate printing establishments, can, box, and paint factories, extensive refrigerator car lines, and meat, fruit, and vegetable refrigerating plants. In addition to the manufacturing side of the business, a wholesale organization has been built up which distributes some of the products throughout practically the entire domestic market.

The manager of a modern business enterprise of any size must be able to trace the exact cost of production of each article, study the markets of the world in order to make wise contracts for sale and purchase, must know how to advertise economically and create or increase his market, must be able to organize and reorganize the departments of his plant, borrow money advantageously, secure favorable transportation rates, stop wastes, work up by-products, and do many other things that were unknown a few years ago. Without the wide use of former waste products, few large enterprises could now maintain themselves. Indeed, so carefully have these been studied that the by-products are at times the chief source of profit, in some cases modern science turning what was formerly a source of trouble and expense into one of great revenue, as was the case in the turning of the injurious sulphur fumes given off in smelting into sulphuric acid. The Tennessee Copper Co., of Copper Hill, Tenn., several years ago was sued for heavy damages by owners of neighboring land because the sulphurous fumes given off by the plant did great injury to the trees and other vegetation around. The expert chemist was called in, and he, by his superior education, was able not merely to stop the injury to the vegetation but to convert these sulphurous fumes into sulphuric acid, one of the profitable by-products of the smelter.

EDUCATION AND INDIVIDUAL SUCCESS.

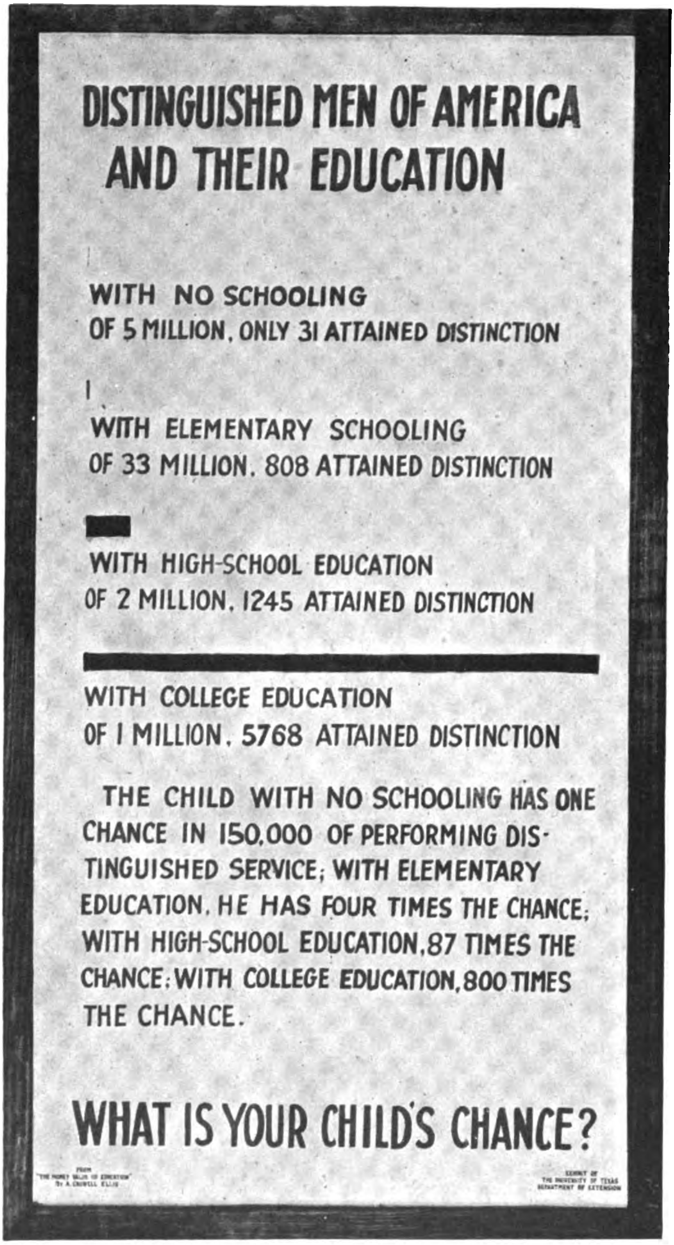
Who's who in America.—That national wealth and industry are dependent primarily on education and must in the nature of things become more and more dependent thereupon as civilization advances is now so obvious that further illustration is unnecessary. That individual education is an equally vital factor in individual efficiency and success in the varied walks of practical life is a matter about which the facts are not so obvious, as the occasional large successes of comparatively unschooled men and the not infrequent failures of men of much schooling have attracted disproportionate attention and obscured the more significant facts. But in recent years several studies have been made which show the influence of education upon individual success.

An investigation of the educational advantages enjoyed by the eight thousand persons mentioned in "Who's Who in America," for the years 1899–1900, brought out the following facts:[1] Out of the nearly five million uneducated men and women in America, only 31 have been sufficiently successful in any kind of work to obtain a place among the 8,000 leaders catalogued in this book. Out of thirty-three million people with as much as a common-school education, 808 were able to win a place in the list, while out of only two million with high-school training, 1,245 have manifested this marked efficiency, and out of one million with college or university training, 5,768 have merited this distinction. That is to say, only one child in one hundred and fifty thousand has been able in America, without education, to become a notable factor in the progress of his State, while the children with common-school education have, in proportion to numbers, accomplished this 4 times as often, those with high-school education 87 times as often, and those with college training 800 times as often. If this list had been selected by the universities or school-teachers, or if literary leaders only were chosen, it might easily be claimed that the apparently greater success of the educated was due to the line of work from which the leaders were selected. But the selection of the men and women in this book was not in the hands of professors, but in the hands of a firm of business men. They selected leaders in all lines of industry, commerce, agriculture, and other fields of practical endeavor besides the professions, and still this enormously increased efficiency and productivity of those with education was found.

In interpreting the results of this study, as in the interpretation of all of the following comparative studies of those who have education with those who do not have it, let it be understood that the remarkable superiority of the educated must not be attributed entirely to their education. Those who receive education are a selected lot to begin with. Their parents were, as a rule, persons of more than average efficiency, and hence were able to keep their children in school; they were more intelligent than the average, and therefore induced or required their children to remain in school. The child himself probably had more than average ability, else he would have wearied of the intellectual labor of the school and would have left it

---

[1] "Who Are the Eight Thousand?" a study by W. W. Smith, chancellor of the Randolph-Macon system. Similar statistics given in "Who's Who in America," p. xix, for 1910–11, and covering 15,794 notable Americans, show results "nearly identical" with those for 1899–1900.



DISTINGUISHED MEN OF AMERICA AND THEIR EDUCATION

WITH NO SCHOOLING
OF 5 MILLION, ONLY 31 ATTAINED DISTINCTION

WITH ELEMENTARY SCHOOLING
OF 33 MILLION. 808 ATTAINED DISTINCTION

WITH HIGH-SCHOOL EDUCATION
OF 2 MILLION. 1245 ATTAINED DISTINCTION

WITH COLLEGE EDUCATION
OF 1 MILLION. 5768 ATTAINED DISTINCTION

THE CHILD WITH NO SCHOOLING HAS ONE CHANCE IN 150,000 OF PERFORMING DISTINGUISHED SERVICE; WITH ELEMENTARY EDUCATION, HE HAS FOUR TIMES THE CHANCE; WITH HIGH-SCHOOL EDUCATION, 87 TIMES THE CHANCE; WITH COLLEGE EDUCATION, 800 TIMES THE CHANCE.

WHAT IS YOUR CHILD'S CHANCE?

Fig. 3.

The figures are taken from a study of the distinguished men catalogued in *Who's Who in America* entitled "Who Are the Eight Thousand," by W. W. Smith.

early. Then, too, the child of educated and well-to-do parents has more opportunity offered him to enter lucrative positions. Other influences also doubtless modify the result; but after due allowance for all these factors is made there remains still a large margin of superior efficiency on the part of the educated that one must credit to education or do violence to common sense in interpretation of the undisputed facts.

The college-bred man in business and in politics.—Dr. Charles Thwing made a similar study of the 15,142 eminent men mentioned in Appleton's Encyclopedia of American Biography to find the facts especially with regard to the relation between college training and success in political life and in amassing wealth.[1]

Of the 100 wealthiest men in the United States he found that in proportion to the total number in America possessing a college education there were 277 times as many college-bred men who had amassed great wealth as there were of noncollege-bred men. In proportion to their numbers in the population, the college men have become Members of the National House of Representatives 352 times as often as the noncollege-bred men; Members of the Senate 530 times as often; President 1,392 times as often; Justices of the Supreme Court 2,027 times as often. Of the more than 10,000 prominent and successful men in all lines mentioned who were still living, 58 per cent were college graduates and 75 per cent had had some college training. On the whole, the college-bred man had attained enough eminence to be mentioned in such a cyclopedia 870 times as often in proportion to his number as the noncollege-bred man.

In 1898 Prof. J. C. Jones, of the University of Missouri, made a special study of the college graduate's success in the field of national politics. This study is doubly pertinent to this subject, for not only do Congressmen, Cabinet officers, Supreme Court judges, and Presidents receive larger salaries than do average citizens, but, since they make, interpret, and enforce the laws which govern customs, banking, transportation, corporations, policing, and international relations, they exert a powerful and wide-spread influence upon national industry and wealth. Prof. Jones made his study[2] also through an examination of Appleton's Cyclopedia of American Biography, but considered only those who had remained in college long enough to graduate instead of including, as President Thwing had done, all who attended college. Prof. Jones found that over five thousand of the fifteen thousand men mentioned in Appleton's were college graduates. He also investigated the schooling of the Fifty-fourth and Fifty-fifth Congresses and found that 36 per cent of the Representatives and over 36 per cent of the Senators were college graduates.

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[1] Amer. Ed. Rev., November, 1908.

[2] "Does College Education pay?" by J. C. Jones, Forum: 26, No. 354–363; Nov., 1898.

Among those who have been elected to the position of Speaker of the House, 47 per cent have been graduates. Furthermore, the proportion is increasing. From 1789 to 1841 the percentage of Speakers who were graduates was 35, whereas from 1841 to 1898 it was 55. Of the Presidents, 55 per cent had likewise been graduates, this percentage also having increased during the preceding 75 years from 50 to 57. Fifty-four per cent of the Vice Presidents, 62 per cent of the Secretaries of State, 50 per cent of the Secretaries of the Treasury, 67 per cent of the Attorneys General, 69 per cent of the Justices of the Supreme Court (87 per cent during the preceding 50 years) were college graduates. As only about 1 per cent of the population ever graduate from college, it is plain that the graduates attain these remunerative and important positions from 36 to 87 times as often as the nongraduates, and that this ratio is still increasing.

The education of the men who framed the Constitution.—As no other one political event has had more to do with national peace and stability, and hence with industrial possibilities, than the framing and adoption of the Constitution, especial significance is attached to the results of Prof. Jones's study of the part which the 1 per cent of college graduates in the country played in this important matter. He found that the author of the Constitution, Thomas Jefferson, was a college graduate; its ablest defender, John Adams, was a college graduate; 23 of the 54 who composed the convention were college graduates, and 27 were college-bred men; 2 of the 3 who brought about the convention—Madison and Hamilton—were college graduates, while the third—Monroe—was a college man; the authors of three of the four plans presented—Madison, Hamilton, and Patterson—were college graduates; the plan finally adopted was that of a college graduate; and after its final adoption the three men who led in explaining it, defending it, and securing its adoption by the States were all college graduates—Madison, Jay, and Hamilton. In fact, the 1 per cent of college graduates in America can almost be said to have called the convention, written the Constitution, and secured its adoption and ratification.

Education and the development of a Western State.—Following quite a different method, Mr. H. E. Kratz made an investigation of the part being played by college-bred men in the recent development of one of the Western States. Mr. Kratz asked men in 15 leading South Dakota cities to name the five leading men in their cities in seven different lines, viz, law, medicine, teaching, the ministry, banking, journalism, merchandising, and manufacturing. Of the 533 men whose names were sent in as leaders in these cities in the several lines, 293, or 50 per cent, proved to have had as much as two years of college training.[1]

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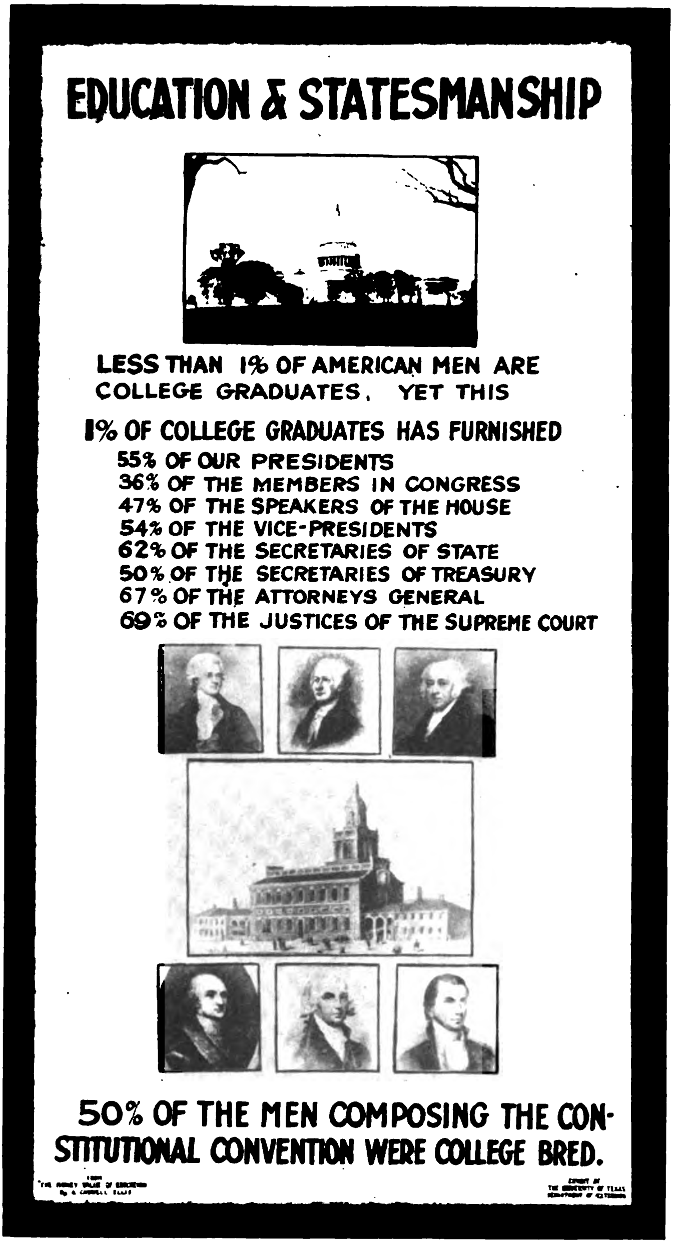
[1] "Does College Education Pay?" by H. E. Kratz, in Educ. Rev.; 27, 298–99; Mar., 1899.



EDUCATION & STATESMANSHIP

LESS THAN 1% OF AMERICAN MEN ARE COLLEGE GRADUATES. YET THIS

1% OF COLLEGE GRADUATES HAS FURNISHED

55% OF OUR PRESIDENTS
36% OF THE MEMBERS IN CONGRESS
47% OF THE SPEAKERS OF THE HOUSE
54% OF THE VICE-PRESIDENTS
62% OF THE SECRETARIES OF STATE
50% OF THE SECRETARIES OF TREASURY
67% OF THE ATTORNEYS GENERAL
69% OF THE JUSTICES OF THE SUPREME COURT

50% OF THE MEN COMPOSING THE CONSTITUTIONAL CONVENTION WERE COLLEGE BRED.

FIG. 4.

The figures are from "Does College Education Pay?" by J. C. Jones in the *Forum*, 26, pages 354–363. The Presidents include all to 1914. The congressional figures are for the Fifty-fourth and Fifty-fifth Congresses. Later Congresses would probably show a larger proportion of college men, as they are more prominent now than in former years in public life. The other figures are to date of the article.

FINANCIAL RETURN OF EDUCATION TO THE INDIVIDUAL.

Individual salary and value to society.—The financial returns which different grades of education make to the individual have been studied recently by two different methods. In some of the studies the investigators went into the factories and other enterprises and found out the amount of schooling that the successful employees in the several grades of work had had. In others they followed out into life the graduates of certain schools and colleges to see what kinds of positions they proved competent to fill and what salaries they received from year to year. The salary paid to an individual because of certain educational qualifications possessed by him represents not only the financial value of that education to him, but also in a general way represents the financial value which the community places upon the service made possible by that education. Some of the results are as follows:

Dodge's study.—One of the earliest of these studies was made by Mr. James M. Dodge, one of the prominent manufacturers of America and former president of the American Society of Mechanical Engineers.[1] Mr. Dodge calculated the financial value of different grades of education by comparing the earning capacities of common laborers, shop-apprentice trained men, trade-school graduates, and technical-school graduates who were employed in the several large factories under his observation. He capitalized at 5 per cent the average annual earnings of 50 weeks of work of a member of each of these classes, and took this sum as the potential value of each when making his comparisons. He concludes:

> A chart thus obtained shows that the laborer starts with $3 a week when he is 16, and rises to $10.20 by the time he is 21, but he rises no higher. His potential value at that wage is $10,200. The apprentice or shop-trained worker starts with the same wages as the laborer at 16, but rises more rapidly, and is earning by the time he is 24 years old $15.80. His potential value at that time is $15,800, but he makes no further rise. The trade-school graduate, starting at the same point, rises still more rapidly, and is earning when he is 25 years of age $22 per week, his potential value at this point being $22,000. From this point his wages rise less rapidly, reaching possibly $25 per week at the age of 32, and representing a potential value of $25,000. The graduate of the technical school starts at the same point of a weekly salary of $3, and is earning $4 when he enters college at 18. Upon graduating from college at the age of 22 he can draw a salary of $13 per week. He has then already passed the laborer, but is still a little below the shop-trained apprentice. He passes the latter, however, during his first year of employment, but is still below the trade-school graduate, whom he does not overtake until his twenty-fifth year. From this point on he rapidly leaves behind the other three workers, and at the age of 32 is drawing $43 a week, his potential value being $43,000. Thus, four years' training at a technical school makes a man, by the time he is 32, four

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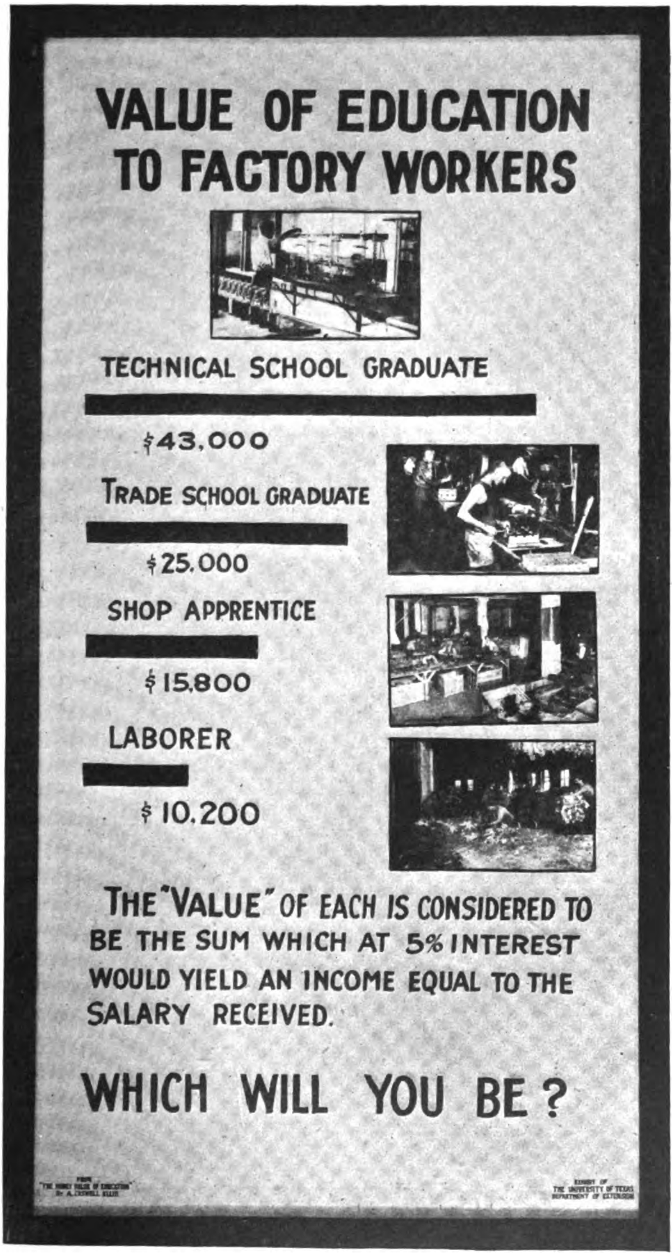
[1] "The Money Value of Technical Training," J. M. Dodge, in the Transactions of Amer. Soc. of Mechan. Engineers, vol. 25.



VALUE OF EDUCATION TO FACTORY WORKERS

TECHNICAL SCHOOL GRADUATE

$43,000

TRADE SCHOOL GRADUATE

$25,000

SHOP APPRENTICE

$15,800

LABORER

$10,200

THE "VALUE" OF EACH IS CONSIDERED TO BE THE SUM WHICH AT 5% INTEREST WOULD YIELD AN INCOME EQUAL TO THE SALARY RECEIVED.

WHICH WILL YOU BE?

FROM
"THE MONEY VALUE OF EDUCATION"
BY A. CASWELL ELLIS

EXHIBIT OF
THE UNIVERSITY OF TEXAS
DEPARTMENT OF EXTENSION

Fig. 5.

The figures are from "The Money Value of Technical Training," by J. M. Dodge, in the Transactions of the American Society of Mechanical Engineers, volume 25, pages 40–48.

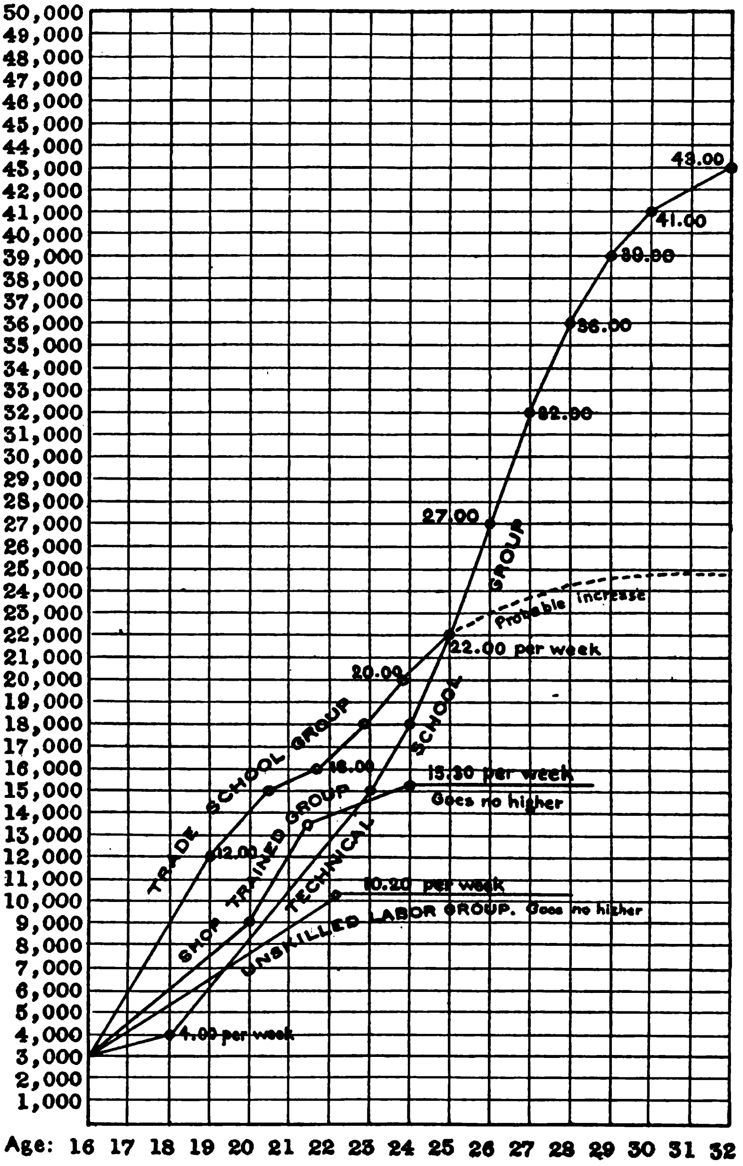


FIG. 6.

Charting the value of education to the factory worker. (See also Fig. 5.)

times as valuable as the laborer, approximately three times as valuable as the shop-trained apprentice, and 72 per cent more valuble than the trade-school graduate—surely a good return for four years spent in preparation.[1]

Mr. Dodge found that even in the lowest grades of factory work the uneducated laborer was often unsuccessful. Only 35 per cent of the unskilled remained in the factory even in unskilled work, 5 per cent went somewhat higher, while 40 per cent had to be dismissed and 20 per cent left of their own accord for one cause or another.

It has been objected to this study that the factories under Mr. Dodge's supervision were not typical ones, but that in them a value was placed upon education above that allowed in other factories. That this is not true is shown by the fact that the salaries reported for the trade-school graduates in the Dodge factories are actually lower than those received in various other factories by the graduates of three widely separated trade schools reported by O'Leary.[2]

The educated fail less often.—Another study of the actual performance of educated men in the business world was made by H. J. Hapgood. Mr. Hapgood's results were similar to those of Dodge and brought out especially the large per cent of successes among college-bred men in responsible, high-salaried positions, and the comparatively small per cent of successes on the part of the noncollege-bred men. He says:

> A notable instance of the value of college men is furnished by the Western Electric Co., which began employing college men about 10 years ago, and has found that 90 per cent of them make good, as compared with 10 per cent of the men who enter business on leaving the high or grammar school.[3]
>
> Statistics based on data gathered from the experience of 100 business houses and covering a period of three or four years show that about 90 per cent of the college men were successful in rising to large salaries and responsible positions, as compared with 25 per cent of the noncollege men.
>
> There is no doubt that college graduates are the chief and best source of supply for the reserve force which every progressive firm should be accumulating.[4]

Factory workers' salaries and education in Massachusetts.—The Massachusetts committee on industrial education made a study of 799 workers who had left school at either 14 or 18 years of age and traced the actual average salaries received by these workers from

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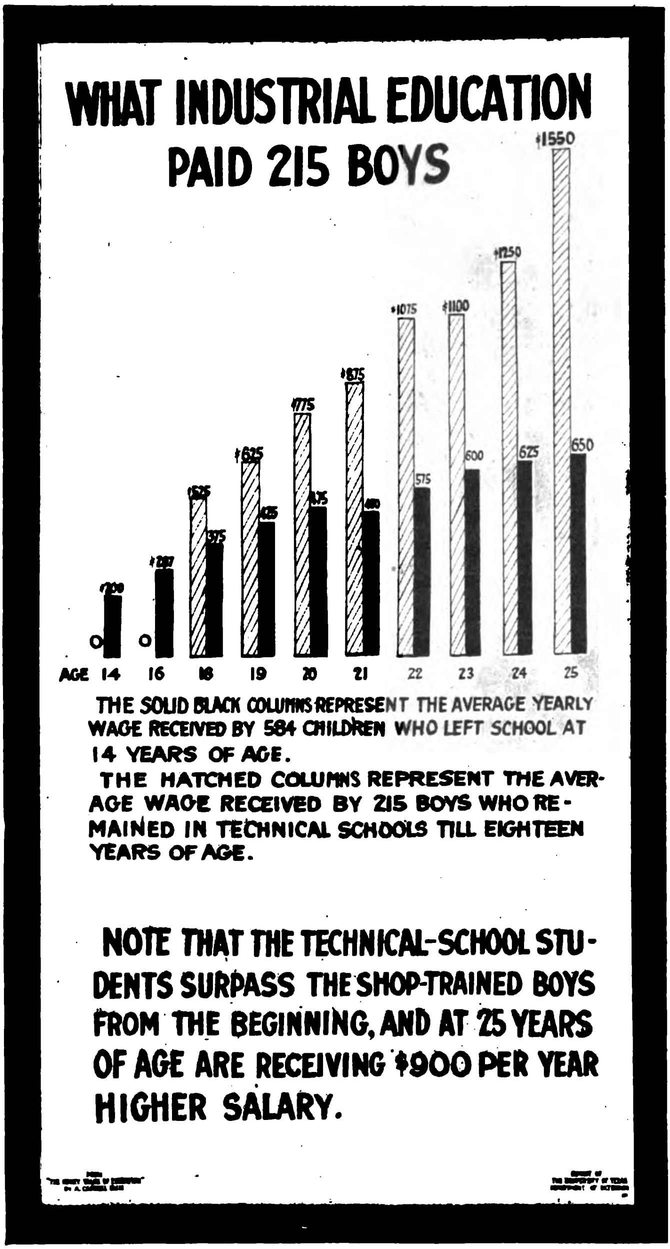
[1] In a private letter to Prof. Person, of Dartmouth College, Mr. Dodge gives this additional information:

"The data of my address on the money value of training were obtained by investigating the records of the Link Belt Engineering Co. and the Dodge Coal Storage Co., the records covering a period of about 14 years. I then had the figures compared with such records as I could obtain from my friends in somewhat similar lines of business, and, for fear of being in error, made a reduction of about 10 per cent from what the actual statistics show."—Quoted by W. A. O'Leary in his report on "The Wage Value of Vocational Training," Appendix VI of the Fourth Report of the New York State Factory Investigating Commission, p. 1420.

[2] O'Leary, W. A. The Wage Value of Vocational Training, p. 1423.

[3] Annals Amer. Acad. Pol. and Soc. Sci., July-December, 1906, pp. 62–63.

[4] Ibid., p. 64.



WHAT INDUSTRIAL EDUCATION PAID 215 BOYS

THE SOLID BLACK COLUMNS REPRESENT THE AVERAGE YEARLY WAGE RECEIVED BY 584 CHILDREN WHO LEFT SCHOOL AT 14 YEARS OF AGE.

THE HATCHED COLUMNS REPRESENT THE AVERAGE WAGE RECEIVED BY 215 BOYS WHO REMAINED IN TECHNICAL SCHOOLS TILL EIGHTEEN YEARS OF AGE.

NOTE THAT THE TECHNICAL-SCHOOL STUDENTS SURPASS THE SHOP-TRAINED BOYS FROM THE BEGINNING, AND AT 25 YEARS OF AGE ARE RECEIVING $900 PER YEAR HIGHER SALARY.

Fig. 7.

The figures were taken from the *Report of the Commission on Industrial and Technical Education*, submitted to the Massachusetts Legislature in 1906.

year to year. They found that boys who had remained four years longer in school in order to take a technical course soon caught up in salary with their brothers who stopped at 14, and went ahead of them so rapidly that by the time they were 22 years old the sum of the four years' salary of the better-educated boys was equal to that of the eight years' salary of those who had quit school at 14. At the age of 25 the boys who had taken four years' extra schooling were on the average getting $900 per year more than those who left school at 14.

From the twenty-fifth year on, the boys who had quit school at 14 would secure practically no promotion, whereas those who had remained in school till 18, and had therefore entered the higher-grade industries and positions, would continue to receive promotion and increase in salary for many years.[1]

If, however, it is assumed that each boy continues for the remainder of his normal working life to receive the same salary that he was paid at 25 years of age, the boy who quit school at 14 would receive a total life income of $26,667, while the boy that remained till 18 would receive $58,900. It thus appears that four years of technical education, from 14 to 18 years of age, more than doubles the earning capacity of the average Massachusetts boy engaged in industry and richly repays both him and the State for the time and money devoted to his education.

It is true that the number of children studied by the commission was small, as was the number of industries inspected. Furthermore, the absolute accuracy of the statements of those studied concerning their wages could not always be proved. It would, therefore, be a mistake to suppose that the above figures are to be taken as exact measures of the value of education in industry even in Massachusetts. On the other hand, this committee was composed of some of the ablest educators and most thoughtful men and women in Massachusetts. It employed trained assistants, visited 354 firms, in 55 different industries, in 43 cities, and personally visited 5,459 employees, out of 9,057, between the ages of 14 and 24 years employed by the firms under observation.

Wages of the trained and untrained.—An illuminating comparison was made by Florence Marshall of the wages received by girls in those occupations demanding no training and those that do demand it. The results are graphically shown in Fig. 8.

An investigation by Miss Anna Hedges of the relation between the education and the wages of a number of women in several factories around New York City showed that education through the fourth

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[1] The commission found (p. 21) that, out of 9,057 employees studied, 900 of whom were in high-grade industries, only 2 per cent of those who had left school at 14 ever got into high-grade industries.

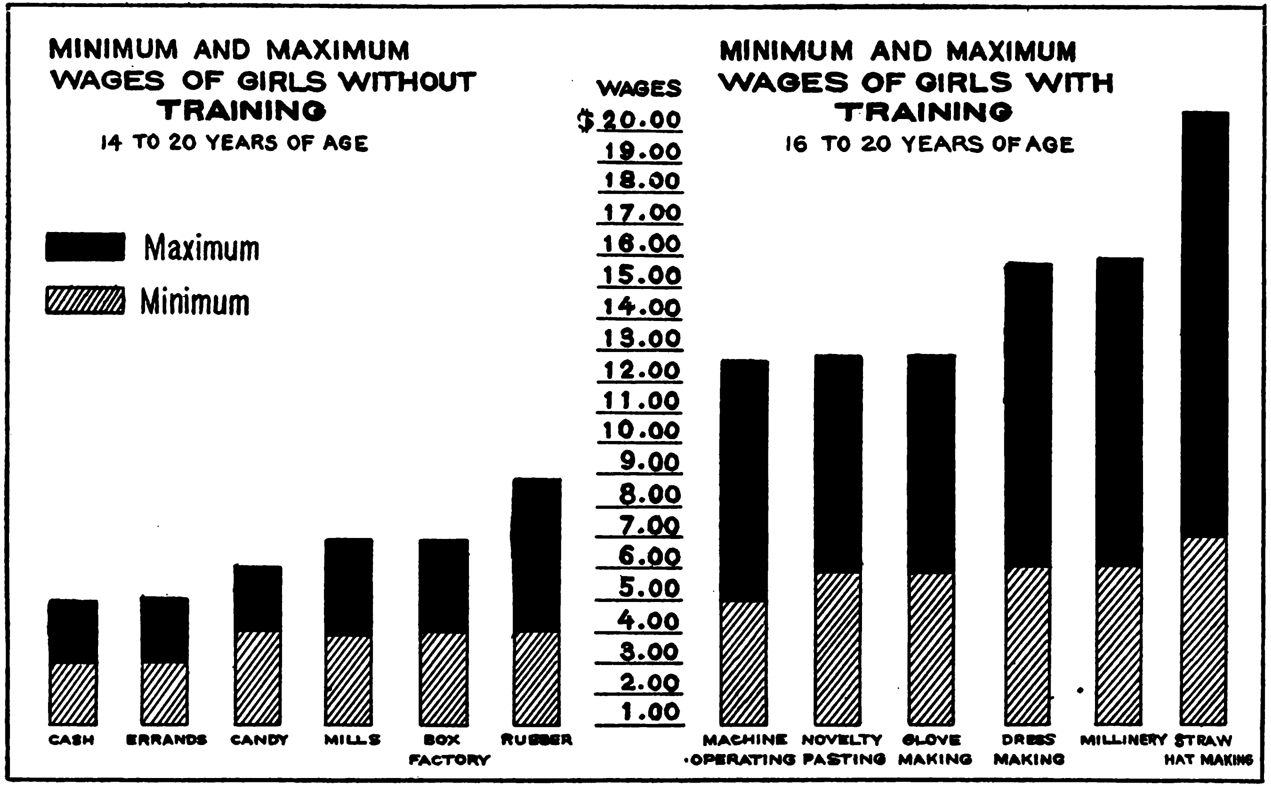

FIG. 8.

Wages of trained and untrained girls. The figures are from "The Public and the Girl Wage Earner, by Florence Marshal, in *Charities and the Commons*, Oct. 5, 1907.

grade increased the wages received by foreign-born girls, but that additional education in the ordinary schools slightly lowered the average earning capacity of these girls in factory work, though it enabled them to reach their maximum salary sooner. This study also showed that the foreign-born girls possessed greater earning power in factory work than the American girls. This apparent reversal of what would be expected is probably due to the low grade of work done by the girls in the factories. For such monotonous routine at machines it is probable that the brighter mind and broadened interests produced by education are a disadvantage. Furthermore, the girls who go into factory work after having many years of schooling are probably below the average in native ability. Miss Hedges says: "High-school preparation turns the attention of most girls to lines of work other than those found in the factory. Those who drift into the factory have perhaps been failures elsewhere."[1]

Education and salaries in New York City.—A committee of the Brooklyn Teachers' Association[2] investigated the salaries received by graduates of the elementary schools and by others who stopped school before graduation. Of 192 boys from the elementary schools taken at random, the committee was able to trace 166 till they were about 30 years of age. At that time the average income of these 166 boys was $1,253.05, whereas the average salary of the illiterate worker in Brooklyn was $500 per year. If the parents of these 166 boys had bought each of them an annuity equal to the extra $753 per year, which his education enabled him to earn, it would have cost over $15,000 per boy. As the salaries of these boys will rise considerably after they are 30, while those of the illiterate laborers will not, it is obvious that this elementary education was worth more than a $15,000 capital safely invested for each boy.

Of 1,600 pupils in the night schools this committee found that wages were being received by them as follows:

Wages received by 1,600 pupils in New York City night schools.

Grade on leaving school.	Average age at leaving school.	Average age at present.	Average wages now.	Number years have worked.
Below 8B	13.3	18.8	$469	5.4
Below 8A	14.1	18.4	424	3.6
First-year high school	15.0	17.0	435	2.0
Second-year high school	15.6	14.0	466	2.4
Third-year high school	15.9	18.0	503	2.1

From the above table it is seen that the pupils who remained through the high school were already, at the end of two years, receiv-

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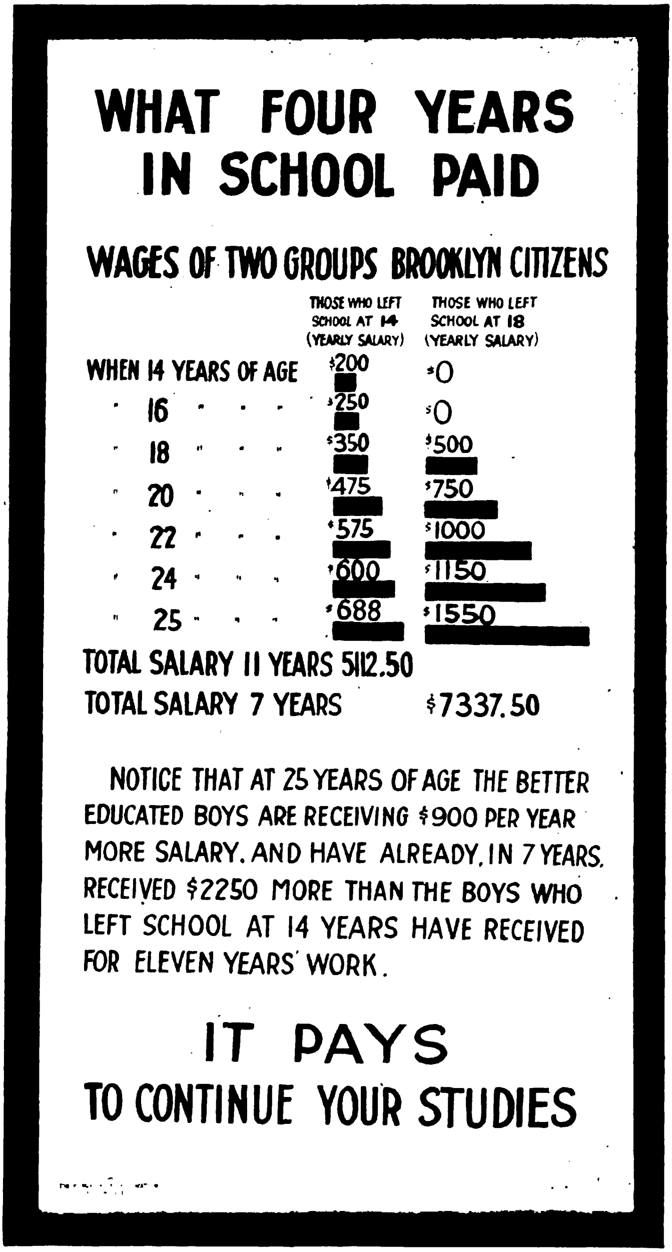
[1] Wage Worth of School Training, by Anna Hedges, p. 143.

[2] Report of the committee on incentives, in the report of the president of the Brooklyn Teachers' Association, 1909.



WHAT FOUR YEARS IN SCHOOL PAID

WAGES OF TWO GROUPS BROOKLYN CITIZENS

	THOSE WHO LEFT SCHOOL AT 14 (YEARLY SALARY)	THOSE WHO LEFT SCHOOL AT 18 (YEARLY SALARY)
WHEN 14 YEARS OF AGE	$200	$0
" 16 " " "	$250	$0
" 18 " " "	$350	$500
" 20 " " "	$475	$750
" 22 " " "	$575	$1000
" 24 " " "	$600	$1150
" 25 " " "	$688	$1550

TOTAL SALARY 11 YEARS 5112.50

TOTAL SALARY 7 YEARS $7337.50

NOTICE THAT AT 25 YEARS OF AGE THE BETTER EDUCATED BOYS ARE RECEIVING $900 PER YEAR MORE SALARY. AND HAVE ALREADY, IN 7 YEARS, RECEIVED $2250 MORE THAN THE BOYS WHO LEFT SCHOOL AT 14 YEARS HAVE RECEIVED FOR ELEVEN YEARS' WORK.

IT PAYS

TO CONTINUE YOUR STUDIES

FIG. 9.

The figures represent the average of actual salaries received by two groups of children that left school at 14 and 18 years of age, respectively, and were investigated by the *Committee on Incentives* of the Brooklyn Teachers' Association.

ing more salary than those who quit at the eighth grade were receiving after more than five years' work. This is especially significant, as these pupils who left at the eighth grade showed that they were pupils of more than average energy and ambition, in that they, five years after leaving school, were still attending night school trying to improve themselves. Their comparatively slow rise in salary is therefore not to be accounted for by laziness or stupidity, though this may with justice be used to account for some part of the inability to succeed usually shown by the illiterate as compared with school graduates.

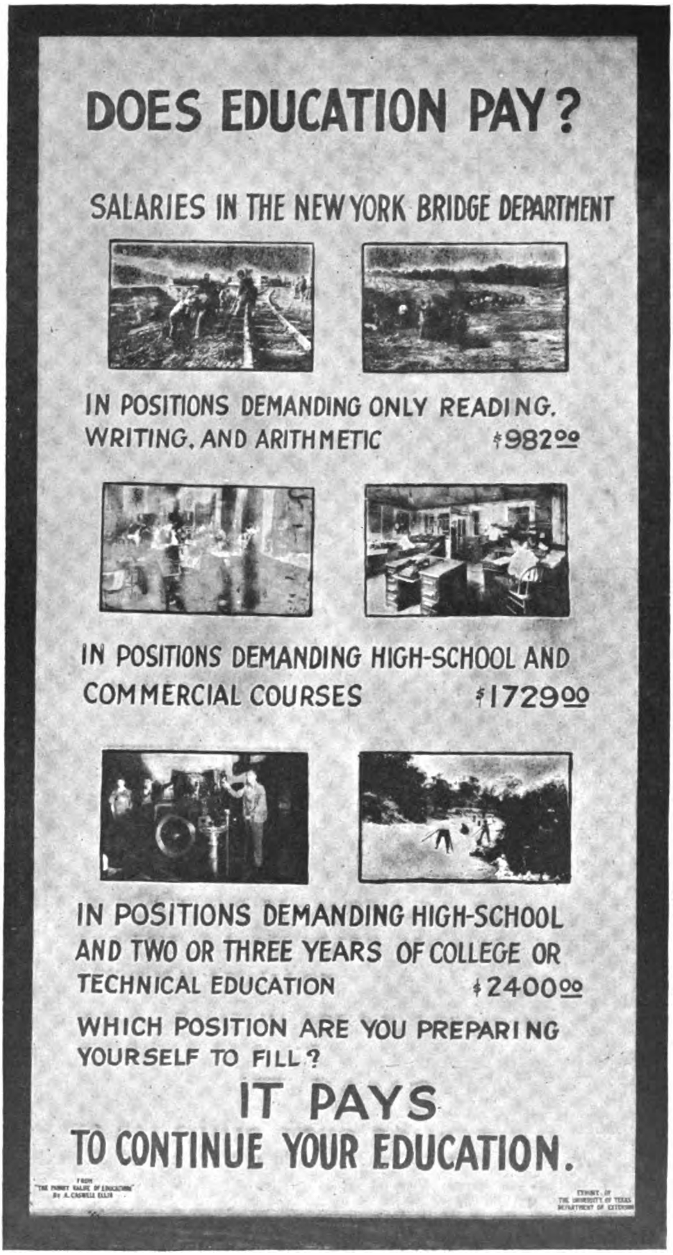
This same committee compared the earnings of the children who left school at 14 years of age with those of the children who remained until they were 18 years old. The average weekly earnings were as follows:

Comparison of wages of children who left New York City schools at 14 years of age with those who left at 18 years of age.

	Left school at 14.	Left school at 18.
Weekly salary when—		
14 years of age	$4.00	0
15 years of age	4.50	0
16 years of age	5.00	0
17 years of age	6.00	0
18 years of age	7.00	10.00
19 years of age	8.50	10.75
20 years of age	9.50	15.00
21 years of age	9.50	16.00
22 years of age	11.75	20.00
23 years of age	11.75	21.00
24 years of age	12.00	23.00
25 years of age	12.75	31.00
Total salary till 25 years of age	5,112.50	7,337.50

It is seen that already, at 25 years of age, the boy who had remained in school till he was 18 had received about $2,000 more salary than the boy who left at 14, and was then receiving over $900 per year more. From this time on the salary of the better educated boy will rise still more rapidly. However, reckoning the average difference in salary at only $900 per year, this equals an annuity that would cost $19,000 if bought from a reliable insurance company—not a bad return for four years of youth devoted to the school.

The committee of Brooklyn teachers also looked into the schedule of salaries paid for various kinds of work which demanded different grades of education. In 2,394 bakery establishments employing 12,000 males over 18 years of age, but requiring only the most elementary education, the average salary paid was $657 per year, whereas in the city departments demanding education equal to that given by a commercial high school the average salary of 1,579 employees was $1,597. In the bridge department of New York City the average pay of 130 men, with an average service of nine years,



DOES EDUCATION PAY?

SALARIES IN THE NEW YORK BRIDGE DEPARTMENT

IN POSITIONS DEMANDING ONLY READING, WRITING, AND ARITHMETIC $982.00

IN POSITIONS DEMANDING HIGH-SCHOOL AND COMMERCIAL COURSES $1729.00

IN POSITIONS DEMANDING HIGH-SCHOOL AND TWO OR THREE YEARS OF COLLEGE OR TECHNICAL EDUCATION $2400.00

WHICH POSITION ARE YOU PREPARING YOURSELF TO FILL?

IT PAYS
TO CONTINUE YOUR EDUCATION.

FROM
"THE MONEY VALUE OF EDUCATION"
BY A. CASWELL ELLIS

EXHIBIT OF
THE UNIVERSITY OF TEXAS
DEPARTMENT OF EXTENSION

FIG. 10.

The figures are from the "Report of the Committee on Incentives" in the *Report of the Brooklyn Teachers' Association for 1909.*

in work demanding no education beyond reading and writing and a little arithmetic, was $982 per year. In the clerical positions demanding the equal of a commercial high-school education the average salary of 31 persons with an average service of 13 years was $1,720 per year. In the engineering department, where high-school graduation and three or four years of college or technical school education were demanded, the average salary of 134 persons with an average service of 7 years was $2,400 per year.

Springfield high-school graduates' salaries.—In 1908 a study was made of the graduates of the commercial department of the Springfield (Mass.) High School from the first class of 1900 to that of 1907. Of the 76 graduates, 67 were followed up completely. The salaries of these graduates are shown in the table below. From this table it is seen that these graduates went out into business at an average salary of about $400, but rose rapidly at an average increase of about $116 per year, those who were out as long as seven years averaging at that time more than $1,000 each year. These salaries will, of course, continue to rise for several years yet.

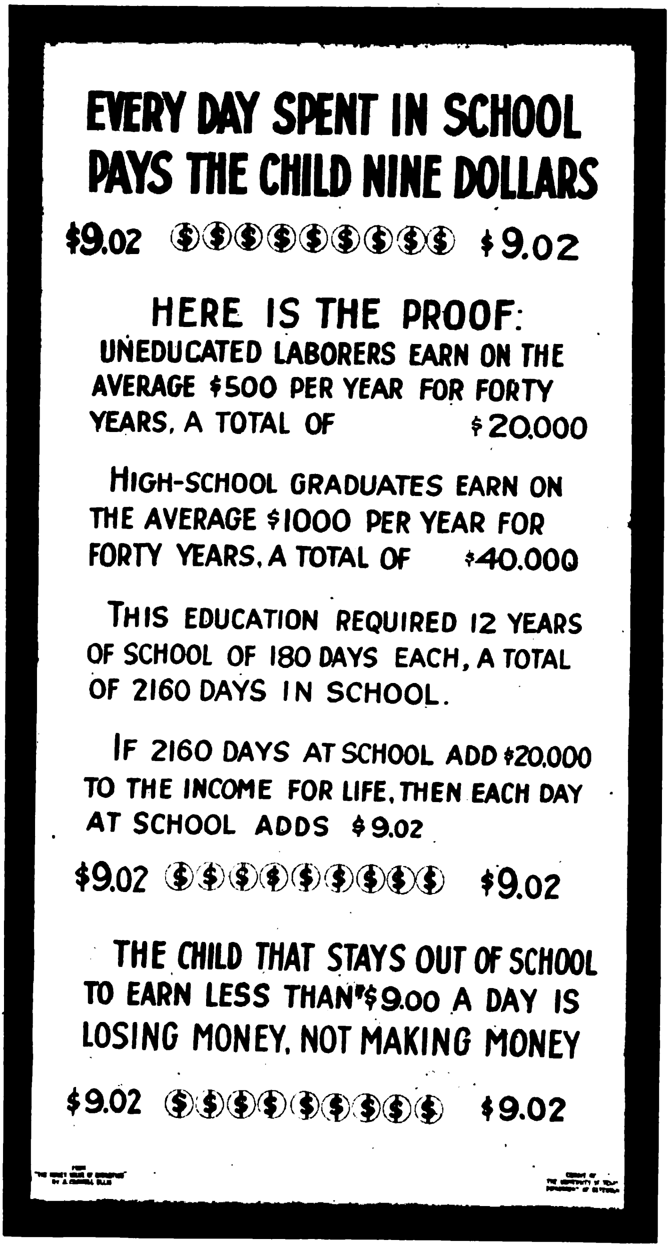
Salaries of graduates commercial department Springfield (Mass.) High School.[1]

Class	Average salary first year.	Average salary, 1908.	Average yearly increase in salary.	Years since graduation.
1900	$308.50	$1,100.00	$105.53	7.5
1901	426.40	994.40	87.39	6.5
1902	321.20	969.80	117.93	5.5
1903	368.67	891.33	116.15	4.5
1904	379.14	813.00	123.91	3.5
1905	517.33	735.33	87.20	2.5
1906	381.33	617.33	153.33	1.5
1907	392.64	461.00	136.72	....
Average annual increase	....	....	116.52	....

[1] High-School Graduates in Business, Sch. Jour., 75: 780, June, 1908.

Every day at school worth nine dollars.—The Springfield and Brooklyn studies represent a fair average of what may be expected as a result of a good school system. The increase above $1,000 in salary of later years will more than compensate for the first few years in which the salary is below this figure. The life expectancy of the average high-school boy is more than 40 years. If we take this average annual salary of $1,000 for a period of 40 years and compare it with the illiterate laborer's salary of $500 per year for the same length of time, we can see how richly the child and the community are repaid for each day the child attends school.

$1,000 for 40 years equals	$40,000
$500 for 40 years equals	20,000
Difference	20,000



EVERY DAY SPENT IN SCHOOL
PAYS THE CHILD NINE DOLLARS

$9.02 (\$)(\$)(\$)(\$)(\$)(\$)(\$)(\$)(\$) $9.02

HERE IS THE PROOF:

UNEDUCATED LABORERS EARN ON THE AVERAGE $500 PER YEAR FOR FORTY YEARS, A TOTAL OF $20.000

HIGH-SCHOOL GRADUATES EARN ON THE AVERAGE $1000 PER YEAR FOR FORTY YEARS, A TOTAL OF $40.000

THIS EDUCATION REQUIRED 12 YEARS OF SCHOOL OF 180 DAYS EACH, A TOTAL OF 2160 DAYS IN SCHOOL.

IF 2160 DAYS AT SCHOOL ADD $20.000 TO THE INCOME FOR LIFE, THEN EACH DAY AT SCHOOL ADDS $9.02

$9.02 (\$)(\$)(\$)(\$)(\$)(\$)(\$)(\$)(\$) $9.02

THE CHILD THAT STAYS OUT OF SCHOOL TO EARN LESS THAN $9.00 A DAY IS LOSING MONEY, NOT MAKING MONEY

$9.02 (\$)(\$)(\$)(\$)(\$)(\$)(\$)(\$)(\$) $9.02

FIG. 11.

Twelve years of 180 days each, or a total of 2,160 days of school, bring the child, therefore, an added life income of $20,000, or a return of between nine and ten dollars for each day spent in school.

Education and earning power in Wisconsin.—Mr. O. B. Staples made a study of the amount of schooling and of the incomes of 500 adults, representing 75 per cent of the population of Lake Geneva, Wis.[1] Of those who had had less than five years of schooling only 22 per cent had an income of over $700 per year, while of those who had had as much as nine years of schooling over 77 per cent were making over $700 per year. This was in spite of the fact that many of those who had attended school for nine years or more were women, who for the same work are paid lower salaries than men, and young high-school graduates who had not been long out of school and hence were just getting a start.

Earning power of Minneapolis school children.—Supt. B. B. Jackson, of Minneapolis, studied the earnings of 3,345 pupils who left school at the end of the eighth grade and found that they started life with an average salary of only $240 per year. A similar study made by him of the salaries of 912 graduates of the high school showed that they started out with an average salary of $600 and after six years were earning an average of $1,380.[2]

Education and farm income in New York.—Warren and Livermore, of Cornell, made a study of 1,303 farmers in four townships of Tompkins County, N. Y. They found that no college graduate had been reduced to the position of a renter, and that only 17 per cent of the renters had more than the district-school education. The average labor income was as follows:

	Per year.
Of 1,007 with district-school education	$318
Of 280 with high-school education	622
Of 16 with college education	847

Of those with high-school education, 20 per cent were making over $1,000 per year, while only 5 per cent of those with district-school education were making that much.[3]

Education and farm income in Indiana.—"A Farm Management Survey of Three Representative Areas in Indiana, Illinois, and Iowa"[4] showed that 273 land owners operating farms possessed education and secured labor incomes as follows:

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[1] Elementary School Teacher, 10: 261–269, Feb., 1910, "Is there a Relation between the Amount of Schooling and Financial Success in Later Life," by O. B. Staples.

[2] Quoted in School Education, Nov., 1914, p. 5.

[3] "Education of Farmers," in An Agricultural Survey, Cornell University, Bulletin 295.

[4] Bul. No. 41, U. S. Dept. of Agr., quoted in Rural Manhood, Sept., 1914, pp. 301-303.

Education and labor income of land owners.

Education.	Number studied.	Average size (acres) of farm.	Average capital.	Average labor income.	Average age.
None at school	4	91	$15,039	$586	55
Common school	214	165	27,494	301	51
High school	46	206	37,725	651	46
College, etc	9	240	48,781	796	53

This table fails to indicate any decided superiority in annual producing power on the part of those landowners with the higher education. The college graduates are $495 a year ahead of the common-school graduates, but on the other hand they have a capital of $42,781 each as against $27,494 for the common-school graduates. The small superiority in income might be due to the superiority in capital. Furthermore, the four totally unschooled men made more on the average than the average made by those with common-school education. Here again the results are not dependable, since four is too small a number to use in getting an average; one exceptional man would put the average far out of place. Then, too, many farm owners put their earnings in improvements to the soil and in upbuilding the farm, so that the real annual production is not shown by the cash labor income.

In the case of renters this large factor of error would be much reduced and the renter's cash labor income would more nearly represent his actual producing power. In this same survey 247 farm tenants also were studied, with the results shown in the following table:

Education and labor income of land renters.

Education.	Number studied.	Average size (acres) of farm.	Average capital.	Average labor income.	Average age.
None at school	4	118	$1,650	$680	49
Common school	186	167	2,200	742	38
High school	51	190	3,203	1,268	33
College, etc	6	294	3,351	1,721	41

In this case the superior labor incomes of those with better education are very noticeable, and especially so the superiority of the much younger high-school graduates over the unschooled and over the common-school graduates. While the high-school graduates have a larger average capital and work larger farms, this difference is hardly enough to account for the superior earning power shown by the high-school graduate in farming. The number of college graduates and of illiterates is too few to serve as a basis for any safe conclusions.

Education helps Missouri farmers.—In 1912 the Missouri College riculture conducted a survey of 656 farms in Johnson County, Mo. Of these farms, 554 had only a district-school education, while 102 had received more than that. It was found that the better educated farmers operated 33 per cent more land and owned four-fifths of the land they operated, as against three-fifths owned by those with only district-school education; they kept one-sixth more stock, worked 14 per cent more land per workman, and earned 71 per cent more clear labor income per year. Prof. O. R. Johnson, in concluding his report of this survey, says:

> While other factors may have played some part in his greater earning capacity, yet from a careful study of the organization of his business it appears that education must have played a very large part in his greater earning ability.

Salaries earned by pupils of Beverly (Mass.) Trade School.—The results of the strictly technical or trade school education have been just as unmistakable as have been those of the schools of general culture. The "Fourth Annual Report of the Trustees of the Beverly Industrial School, 1912," gives the earnings from year to year, as they passed through the school, of the 12 graduates who had spent two and a half years in the school. This school requires as part of its course of study actual piecework in the mills under all the requirements and conditions of ordinary factory work, except the additional instruction given by teachers and the part time devoted to school work. Summing up these results, the secretary says:

> The wage-earning capacity of these boys when they entered school is conservatively estimated at $6 per week * * *. The wage-earning capacity of these boys at the time of graduation ranged from $15 to $18 per week. In 120 weeks of shopwork under school directions the boys increased their average earning power in competition with other workmen and under actual factory conditions by more than 250 per cent and were, in fact, earning at the close of the period wages at the rate of $800 per year.

These final salaries are not estimates, but are actual amounts earned by these boys in the factory working on full time at the end of the school course. That the practical machinists appreciate the value of this school work is shown by the fact that while only 5 machinists and metal workers in 1910–11 sent their sons, 22 sent them in 1911–12, of whom 20 were from one of the big factories in which the school boys had been given part of their practice work.

The Baron de Hirsch Trade School.—This school takes in young men who are already at work and gives them 5½ months of trade education. These young men are usually those who have gone out of the public schools early and found themselves making unsatisfactory progress in industry. The wages of 839 of the graduates of this school were studied and gave the following interesting results:[1] These graduates had entered the school at an average of 17½ years of age, when they were receiving an average of $6 per week, with poor prospects of increase. Immediately on graduation they earned on the average $7.28 per week and within two years were earning $12 per week, with prospects of more or less steady further increase for 10 or 20 years. One hundred and fifty-eight machinists that entered at an average salary of $6.66 went back to work after five and a half months of schooling at an average of $8.96 per week; 66 carpenters that entered at $6.14 went out at $9.01 per week; and 270 electricians that entered at $5.76 went out at $7.12 per week. Of more value than the 24 to 47 per cent increase in wages resulting from the six months' school training was the great prospect for continued future advance for many years, as opposed to the early maximum salary reached by the untrained.

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[1] Taken from the report of the national commission on vocational education, by W. A. O'Leary in his "Report on the Wage Value of Vocational Training," pp. 1437–40.

Graduates of the Milwaukee School of Trades.—The wages received by 25 graduates of the Milwaukee School of Trades who went into the pattern-making industry were investigated and compared with the wages of others who entered this field through apprenticeship. During their four years of apprenticeship the apprentices each received a total of $1,433.75. During the first two years after leaving the trade school those entering this industry from the trade school received on the average a total of $1,635.92. It thus appears that before he is 20 years of age the trade-school graduate had received in two years a larger total salary than the apprentice had in four years and was already well ahead of him in the wage scale. The president of the school writes: "I am convinced that if we follow up the experiences of the graduates of the other three trades, we would find even greater advantage gained."[1]

Graduates of the New York Vocational School for Boys.—The New York Vocational School for Boys gives only two years' preparatory trade training to 14-year-old boys, or younger boys who have completed the grammar school. The records of the salaries of all the first graduates of this school after six months of employment, as compared with nongraduates working in the same lines, were as follows:

Wages of vocational graduates and nongraduates compared.

Trade.[2]	Average wage of graduate.	Average wage of non-graduate.
Architectural and mechanical drawing	$9.50–$11.50	$6.50
Carpentry	6.00– 11.25	4.74
Machine shop	7.50– 13.13	$4.73– 6.18
Electric wiring	8.40– 12.94	5.90– 7.25

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[1] Report on the Wage Value of Vocational Training, by W. A. O'Leary, pp. 1426–27.

[2] Quoted from the report of the principal of the New York Vocational School for Boys for 1911–12, by W. A. O'Leary in his "Report on the Wage Value of Vocational Training," p. 1430.

Graduates of the Rochester Shop School.—The records of 36 graduates of the Rochester Shop School were compared with those of 696 other boys in the same city who left the grammar school at 14 to 16 years of age. The boys are admitted to this shop school at 14 years of age. The 36 spent on the average 14.9 months in the school. The average wage of these shop-trained boys on leaving the school was $7.50 per week, which rose to $9.06 by the end of 12.5 months. The untrained boys, on the other hand, averaged only $4.89 per week during the year and had changed jobs on the average every 17 weeks, whereas the trained boys held their jobs on the average for 12.5 months. Over 95 per cent of the untrained boys were still in the unskilled occupations with no outlet or hope of promotion, whereas 94 per cent of the trained boys were in skilled industries with good prospects of promotion.[1]

Earnings of graduates of Lowell Textile School.—The authorities of the Textile School of Lowell, Mass., are quoted in the American School Board Journal[1] as follows:

> Results of a recent canvass of the alumni lead to the belief that nearly 60 per cent of the graduates from the day classes are receiving a salary of over $1,000 a year; 20 per cent are receiving $2,000 a year and over, with some cases of $4,000, $5,000, and $7,000 salaries. The first graduate has not yet been out from the school 10 years.

Earning power of graduates of Newark Evening Technical School.—The New Jersey commission on industrial education in 1908 made a careful study of the salaries of the graduates of the Newark Technical School, which had been in existence long enough (since 1884) to show clearly what was the effect of its training. Definite information as to salaries received was secured from 85 per cent of these graduates. The condition of the other 15 per cent was looked into by the commission enough to convince them that the results secured from the 85 per cent would apply equally well to those from whom they did not get definite replies to their questions. These students carried on remunerative work at the same time that they were studying in this school. The average graduate was found to have begun his work at 14 years of age at a salary of $3.55 per week, and to have risen rapidly until at 37 years of age the average salary was $42.03 per week. Those in the machine trades had begun at $3.76 per week and had gone to $57.17 per week by the time they were 37 years old.

The United States census at that time showed the average salaries paid in the country to be approximately as follows:

Unskilled machine industries	$8
Unskilled building trades	12
Skilled machine trades	18
Skilled building trades	23

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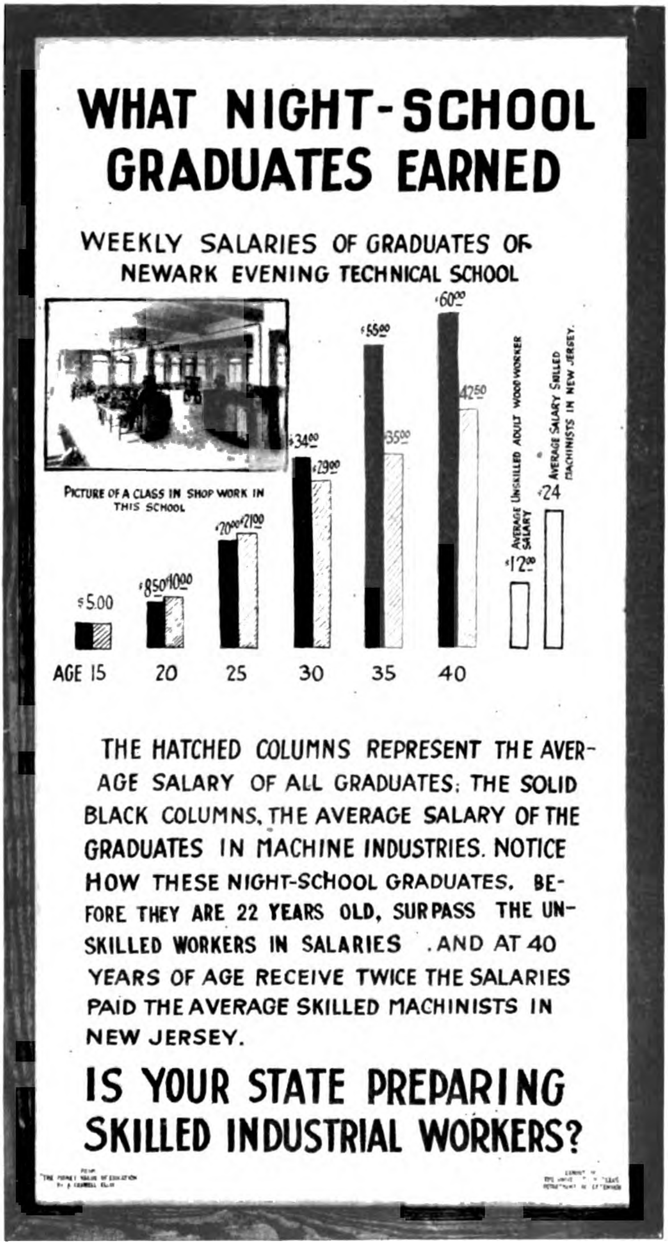
[1] Taken from the report of the board of education of the city of Rochester for 1913, by W. A. O'Leary in his "Report on the Wage Value of Vocational Training," pp. 1430–31.

[2] May, 1909, p. 25.



WHAT NIGHT-SCHOOL GRADUATES EARNED

WEEKLY SALARIES OF GRADUATES OF NEWARK EVENING TECHNICAL SCHOOL

PICTURE OF A CLASS IN SHOP WORK IN THIS SCHOOL

THE HATCHED COLUMNS REPRESENT THE AVERAGE SALARY OF ALL GRADUATES; THE SOLID BLACK COLUMNS, THE AVERAGE SALARY OF THE GRADUATES IN MACHINE INDUSTRIES. NOTICE HOW THESE NIGHT-SCHOOL GRADUATES, BEFORE THEY ARE 22 YEARS OLD, SURPASS THE UNSKILLED WORKERS IN SALARIES . AND AT 40 YEARS OF AGE RECEIVE TWICE THE SALARIES PAID THE AVERAGE SKILLED MACHINISTS IN NEW JERSEY.

IS YOUR STATE PREPARING SKILLED INDUSTRIAL WORKERS?

FIG. 12.

The figures are from the *Report of the New Jersey Commission on Industrial Education.* This school was established in 1884. The salaries of 85 per cent of the graduates were secured. Others not secured were thought to be equally good. This is a night school, the students earning salaries in regular work during the day.

Those boys, then, by taking the training offered in that school had made themselves over seven times as valuable as average unskilled machinists and over three times as valuable as average skilled machinists.

Further recognition of the value of education in increasing efficiency is seen in the establishment by the railroads and by numerous large business enterprises at their own expense of special courses, night schools, and day schools for their employees. They have found it impossible to secure from our present inadequately equipped school system the supply of well-educated workers that they need.

Value of education in a railroad shop.—In answer to a question as to what, if any, increase in the value of their workmen had been brought about by a quite complete system of shop trade schools which had been introduced, the representative of a large railroad corporation replied:

> We have ascertained that the efficiency of apprentices has increased 25 per cent; that is, on account of our system of instruction they are able to accomplish that much more work than they could before we adopted our present apprentice system. We are, through the medium of our skilled shop instructors, able to use the apprentices on all classes of work, while formerly they were engaged in the simpler classes of work as well as on the simpler machines. Under our present system, however, we are able to use apprentices on any machine, even the most complicated. While we can not measure this in percentage or even dollars and cents, it is a matter of great convenience; especially is it so when a regular man operating some difficult and complicated machine lays off a few days, and it is not economical to put another man in his place on account of not being familiar with the work of the machine; in lieu of which we place an apprentice on the machine and with the help of the instructor he is able to give a fair day's output. In this alone we can save fully 25 per cent.
>
> We have found also that our graduated apprentices' earning capacity has increased 18 per cent over and above those who did not have the advantage of our apprentice instruction. This fact is particularly emphasized by our shop foremen, who greatly prefer having one of our apprentice graduates than to have a mechanic who has served an apprenticeship on other roads and who has not enjoyed the benefits of our present apprentice system.
>
> While all these percentages are not accumulative, you can safely bank on about 25 per cent increase in efficiency in the boys, due to our method of training and educating them.
>
> Another great advantage I should mention is that when our apprentices are graduates they are capable of operating any machine or doing any class of work in the department in which they have served their apprenticeship. While this can not always be measured in dollars and cents, it is of immense benefit and value to the officers in charge of the shop, as they always have young mechanics in the shop who can perform any class of work which may arise, and one man's leaving the service will not tie up a single machine nor cripple the service.[1]

In considering the value of these several studies it could be said that Mr. Dodge was an exceptional employer, and that the work of

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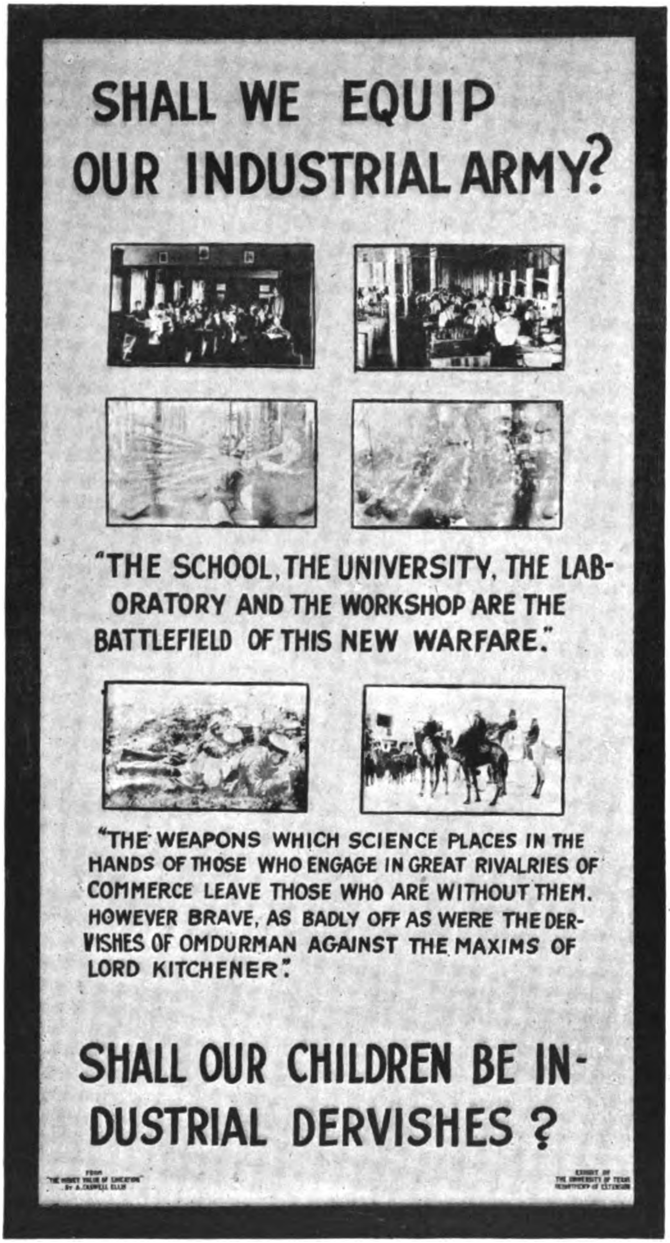
[1] Quoted by W. S. O'Leary in his Wage Value of Vocational Training, pp. 1431–32.



SHALL WE EQUIP
OUR INDUSTRIAL ARMY?

"THE SCHOOL, THE UNIVERSITY, THE LABORATORY AND THE WORKSHOP ARE THE BATTLEFIELD OF THIS NEW WARFARE."

"THE WEAPONS WHICH SCIENCE PLACES IN THE HANDS OF THOSE WHO ENGAGE IN GREAT RIVALRIES OF COMMERCE LEAVE THOSE WHO ARE WITHOUT THEM, HOWEVER BRAVE, AS BADLY OFF AS WERE THE DERVISHES OF OMDURMAN AGAINST THE MAXIMS OF LORD KITCHENER."

SHALL OUR CHILDREN BE INDUSTRIAL DERVISHES?

Fig. 18.

The first quotation is from Sir Norman Lockyear's "Brain Power in History." The second is cited by Sir Norman from a speech by Mr. Haldane.

the General Electric Co. represents an unusual type of work that especially demands education; that the Massachusetts commission did not study enough cases; that the studies of the Brooklyn teachers did not include always a large enough per cent of the pupils of the school, and so on for the rest of the numerous studies. Any one of these studies may not be conclusive, but when all of them point so clearly and without exception to the greatly superior earning power of the educated, the conclusion is irresistible.

SALARIES OF COLLEGE GRADUATES.

Earnings of Princeton graduates.—In the "Decennial Record of the Class of 1901, Princeton University," a report is given of the salaries received by the members of this class during the first 10 years after graduation. The number from whom reports were secured each year varied slightly, but on the first year 111 reported an average salary of $706, which by the fifth year increased to $2,039.42, and by the tenth year, with 149 reporting, reached $3,804. This high average is in spite of 19 teachers and clergymen in the class, whose average salary in the tenth year was between $1,700 and $1,800—about half what the classmates in other professions and in business were receiving. The Princeton class of 1906 likewise started out with an average salary reported of $859.60, which at the end of five years had risen to $2,225.80, showing practically the same rate of increase as was seen in the class of 1901.[1]

Earnings of Yale graduates.—A study has also been made of the salaries received for the first five years by those who went out in 1906, both graduates and nongraduates, from the Sheffield Scientific School of Yale.[2] Reports were secured from 188, or about two-thirds of the class, showing that the average salaries received were as follows:

First year	$683.85
Second year	898.30
Third year	1,257.24
Fourth year	1,686.14
Fifth year	2,040.04

Earnings of a Harvard law-school class.—A similar study of the Harvard law class graduating in 1905 showed that two years after graduating, with 163 reporting, they were receiving an average salary of $1,188, and that five years after graduation, with 151 reporting, the average had climbed to $2,616.[3]

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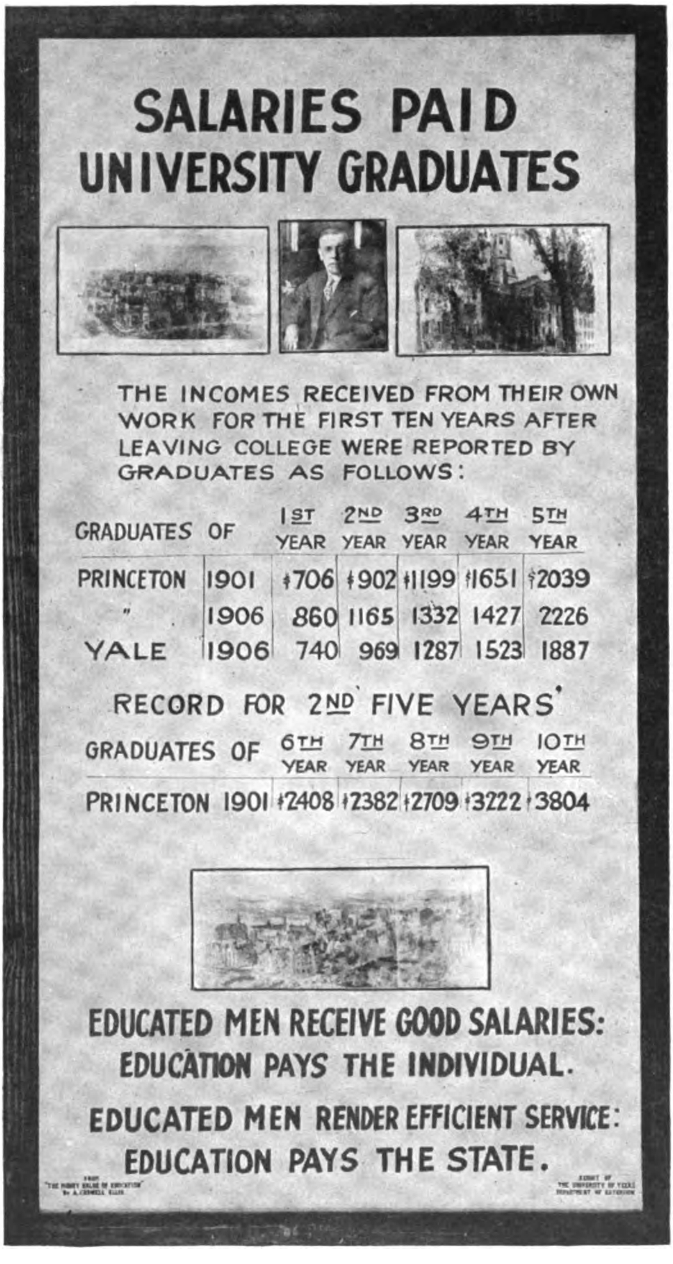
[1] The Decennial Record of the Class of 1901, Princeton University, pp. 344–345, and the Fifth Record of the Class of 1906, Princeton University, pp. 245–259.

[2] Yale Alumni Weekly, 22: 6, Sept. 20, 1912.

[3] Yale Alumni Weekly, 21: 244–45, June 19, 1912.



SALARIES PAID
UNIVERSITY GRADUATES

THE INCOMES RECEIVED FROM THEIR OWN WORK FOR THE FIRST TEN YEARS AFTER LEAVING COLLEGE WERE REPORTED BY GRADUATES AS FOLLOWS:

GRADUATES OF		1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR
PRINCETON	1901	$706	$902	$1199	$1651	$2039
"	1906	860	1165	1332	1427	2226
YALE	1906	740	969	1287	1523	1887

RECORD FOR 2ND FIVE YEARS

GRADUATES OF	6TH YEAR	7TH YEAR	8TH YEAR	9TH YEAR	10TH YEAR
PRINCETON 1901	$2408	$2382	$2709	$3222	$3804

EDUCATED MEN RECEIVE GOOD SALARIES:
EDUCATION PAYS THE INDIVIDUAL.

EDUCATED MEN RENDER EFFICIENT SERVICE:
EDUCATION PAYS THE STATE.

FIG. 14.

The figures are from "The Fifth-Year Record of the Class of 1906, Princeton University," pages 245–259. Reports were from about two-thirds of the members of the classes. In the same way 10 years after graduation the class of 1899 of Dartmouth reports an average income of $2,097; the class of 1903 of Northwestern University an average of $1,863 for the fifth to tenth year after graduation; and the Harvard law class of 1905 reports an average of $2,616 the fifth year after graduating in law.

Earnings of Northwestern graduates.—Northwestern University made an investigation of the salaries received by its graduates of 1903[1] and found that during the first five years these averaged $867 and for the next five years $1,862 per year. While this seems lower than the salaries reported from the eastern universities, it must be remembered that the average salary for the last five years and not the average salary of the tenth year is given. It should also be remembered that 10 years after his graduation the average college man is only a little over 30 years old, and has a prospect of continued increase in salary for another 10 or 20 years.

Earnings of Dartmouth graduates.—In 1909 reports were secured from 67 out of 100 of the class of 1899 of Dartmouth College, which showed that the average salary received by these men 10 years after graduation was $2,097.25.[2]

Salaries of University of Texas graduates.—In reply to a questionnaire sent out by Mr. E. V. White concerning the earnings of the 192 graduates of his class (1903) of the University of Texas, 76 reported. In these reports personal earnings (wages, salaries, and professional fees) were reported separate from income from inherited property or speculation. Fifty-four of the students reporting had earned part or all of the money expended on their education, and hence represented not even well-to-do families. Average annual salaries reported by these graduates were as follows:

Salaries of graduates of the University of Texas.

		First year.	Third year.	Fifth year.	Eighth year.	Tenth year.
Academics	Men	$686	$1,223	$2,111	$2,462	$2,522
	Women	559	607	842	1,031	1,015
	Average	639	1,022	1,605	1,985	2,108
Lawyers		668	1,278	1,915	3,097	3,812
Engineers		857	1,160	1,430	1,803	2,008
Doctors		1,092	1,942	2,750	3,500	4,467
Pharmacists		636	1,076	1,250	1,375	1,850
Average		708	1,219	1,822	2,498	2,943

In reply to the objection that these do not represent fair averages of the graduates' wages, because only those who have good salaries would answer such a questionnaire, Mr. White writes that he is personally acquainted with many of those not reporting and knows that many of them have even better salaries than the averages given above.[3]

Increased earning power of evening students in Pennsylvania School of Finance and Accounts.—The rate of increase in salaries from year to year of the students who have attended the night School of Finance and Accounts of the University of Pennsylvania while continuing their regular business occupations during the day presents another remarkable instance of the immediate financial returns from education. Three hundred and fifty men graduated from this evening school in seven years, beginning in 1907. The average salaries of these students on entering the school, the salaries in 1913, the percentage of annual increase, and the total increase were as follows:[1]

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[1] The Dial, 55, No. 649, p. 10, July 1, 1913.

[2] H. A. Miller, Science, N.-S. 34, 789–90; Feb. 4, 1910.

[3] The above is taken from a manuscript report prepared by E. V. White, now dean of the Texas College of Industrial Arts.

Salaries of students before entering and after leaving the University of Pennsylvania Evening School of Finance and Accounts.

Year of enrollment.	Year of graduation.	Average salary on enrollment.	Average salary, 1913.	Per cent increase.	Per cent increase per annum.
1904....	1907	$1,040	$3,120	198	22
1905....	1908	956	3,347	250	31
1906....	1909	1,003	2,700	179	26
1907....	1910	1,044	1,869	79	13
1908....	1911	940	1,690	79	16
1909....	1912	807	1,411	75	19
1910....	1913	753	1,480	96	32

Average annual increase, 23 per cent.

It will be seen that those students who entered in 1904, having an average salary of $1,040, have increased it on the average 22 per cent each year, and nine years later have an average salary of $3,120. Those who entered in 1905 with an average salary of $956 progressed even more rapidly, making gain in salary of 31 per cent a year and reaching in eight years an average of $3,347 per year. The record for all classes taken together shows an average increase in salary of the entire body of graduates of 23 per cent a year. Business men are not in the habit of increasing the salaries of their employees 23 per cent a year, or giving to them average salaries of over $3,000. If these students are promoted at that rate and receiving such salaries, then their training in school must have given them an increased efficiency somewhat in proportion to their increased salaries.

Superior earning power of graduates of schools is a demonstrated fact.—Such studies as the above, while open to the criticisms that have been mentioned before, because of the fact that the educated are a selected set to begin with, have nevertheless answered unmistakably the question as to whether the schools, with all their admitted imperfections, are preparing their pupils for greater economic efficiency. The figures show conclusively that the schools are giving their pupils a greater earning power than even the strongest advocates of education had claimed. Inevitably, as the economic processes become more complex, the relative need for directive force in industry becomes greater and greater. Experience has shown that only through a thorough system of public schools and colleges can a State or nation provide for itself an adequate supply of citizens capable of furnishing this necessary directive force.

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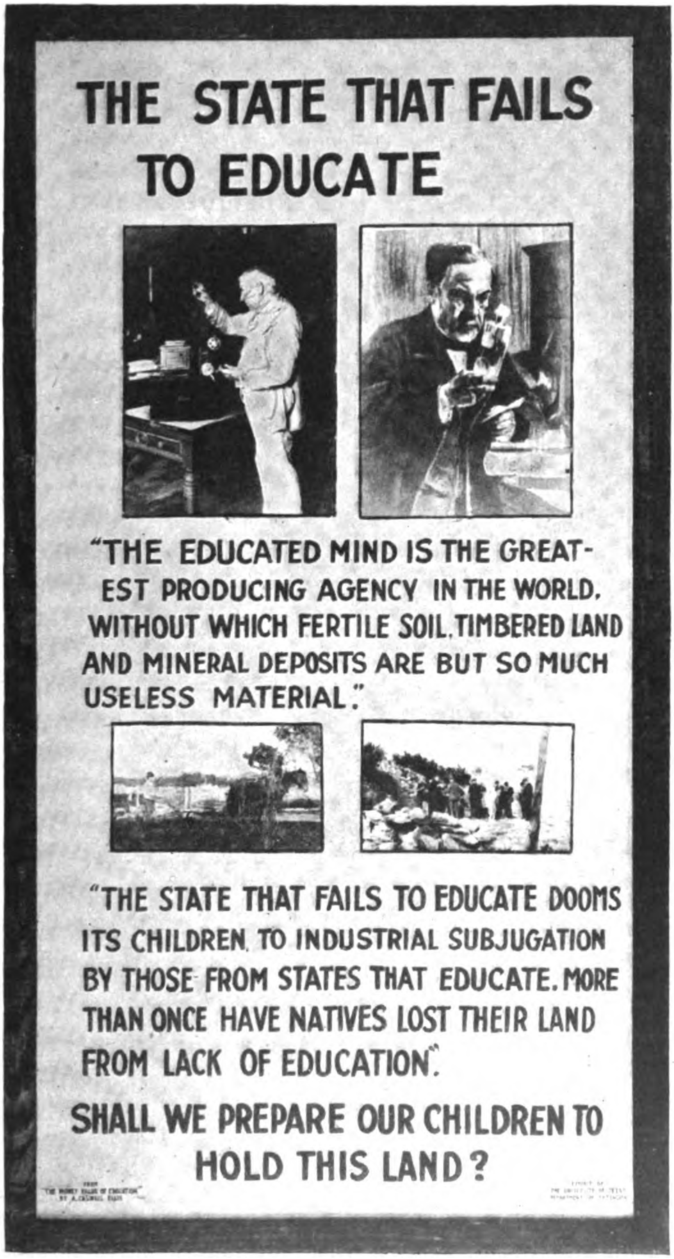
[1] Old Penn Weekly Review, 1913, p. 202.



THE STATE THAT FAILS
TO EDUCATE

"THE EDUCATED MIND IS THE GREATEST PRODUCING AGENCY IN THE WORLD, WITHOUT WHICH FERTILE SOIL, TIMBERED LAND AND MINERAL DEPOSITS ARE BUT SO MUCH USELESS MATERIAL."

"THE STATE THAT FAILS TO EDUCATE DOOMS ITS CHILDREN TO INDUSTRIAL SUBJUGATION BY THOSE FROM STATES THAT EDUCATE. MORE THAN ONCE HAVE NATIVES LOST THEIR LAND FROM LACK OF EDUCATION".

SHALL WE PREPARE OUR CHILDREN TO
HOLD THIS LAND?

FROM
"THE MONEY VALUE OF EDUCATION"
BY A. CASWELL ELLIS

FIG. 15.

LIST OF REFERENCES ON THE MONEY VALUE OF EDUCATION.

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Agricultural education pays. School education, 34:36, September, 1914.

Data collected by the New York state school of agriculture, Alfred, N. Y.

Brooklyn teachers' association. Sub-committee on school incentives. Industrial efficiency. *In its* Report of the president, 1908–1909. Brooklyn, N. Y., 1909. p. 25–29.

Campbell, M. Edith. Economic value of education. *In* National child labor committee. Proceedings, 1912. p. 66–72.

Clark, Melvin G. [Statistics showing that an education pays.] Journal of education, 78:109–10, July 24, 1913.

Dill, James B. Education an element of business success. New York associated academic principals. Proceedings, 1900. p. 605–621. [New York State University. High school department. Bulletin 12, April, 1901.]

Do farmers need education? Associate teacher, 15:6, May, 1914.

Figures by the U. S. Department of Agriculture, showing the value of education to a farmer.

[Earning capacity of school children.] American school-board journal, 47:54. July, 1913.

States the amounts earned by pupils of different grades during summer in St. Cloud, Minn.

Eckels, J. H. The financial value of education. National education association. Journal of proceedings and addresses, 1907, p. 165–170.

Shows that modern business demands wide education.

[Education and earning power.] American educational review, 30:75, November, 1908.

Opportunities for education.

[Education and success.] North central association of colleges and secondary schools. Proceedings, 1902. p. 5–8.

General statements only.

Education in successful farming. Rural manhood, 5:301–303, September, 1914.

Based on Bulletin 41 of the United States Department of agriculture, by E. H. Thomson and H. M. Dixon. A brief extract from the same source also appears in the Associate teacher, 15:6, May, 1914.

Johnson, O. R. The value of education to the farmer. University of Missouri Agricultural Experiment Station. Circular no. 77, 1915.

Reports a survey of 656 farms in Johnson County, Mo.

Jones, E. D. Relation of education to industrial efficiency. American economic review (supplement), 5, 209–33, March, 1915.

Lewis, E. E. The financial value of general education. Midland schools. 30:201–203, March, 1916.

Quotes results of several studies reported in other articles in this bibliography.

——— Work, wages, and schooling of eight hundred Iowa boys. University of Iowa. Extension bulletin, no. 9, February, 1915.

A study of more than 800 Iowa boys who quit school before graduation. No comparison is made in rate of advancement in salary of boys with much and boys with little education.

Marshall, Florence. The public school and the girl wage earner. Charities and the commons, 19: 849–51, October 5, 1907.

Compares salaries in occupations demanding training and those demanding little or none.

Massachusetts. Commission on industrial and technical education. What the value of the years from fourteen to sixteen might be to boys. *In its* Report, 1906. New York, Teachers college, Columbia university [1906]. p. 57–69.

——— ——— What the value of the years from fourteen to sixteen might be to girls. *In its* Report, 1906. New York, Teachers college, Columbia university [1906]. p. 70–84.

The money side of education. Christian student, 11: 26–27, May, 1910.

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Claims that each school day is worth $11.50 to the student.

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Phillips, John Burton. Relation of the course of study to higher wages. Education, 26: 470–73, April, 1906.

Salaries of educated man compared with salaries of the illiterate man. Missouri school journal, 25: 445, October, 1908.

Schaeffer, Nathan C. Does education pay in dollars and cents? *In* New Jersey state teachers' association. Proceedings, 1901. p. 62–73.

——— What is a boy's time worth? American educational review, 30: 258–59, March, 1908.

Smith, W. W. Who are the eight thousand?

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STEVENSON, F. G. A high school education as a financial investment. For the consideration of our friends, the boys, who have not yet finished school but who may be thinking of quitting to take a "job." Sierra educational news, 9: 726–27, November, 1913.

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——— The money value of training. St. Nicholas, 31: 57–65, November, 1903.

Address delivered by Mr. Dodge, president of the American society of mechanical engineers, at Williamson trade school, Philadelphia, March, 1903.

Earning power of Technology alumni. Technology review, 14: 195–201, April, 1912.

Massachusetts institute of technology.

A collection of interesting statistics bearing on the earning capacity of Institute men, taken from class reports during the last fifteen years.

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HEDGES, ANNA CHARLOTTE. Wage worth of school training. Teachers college. Columbia university. Contributions to education, No. 70.

A study of 600 women workers in textile factories.

HUMPHREYS, ALEXANDER CRUMBIE. The economic values of industrial education. *In* National society for the promotion of industrial education. Proceedings, 1909. p. 26–38. (*Its* Bulletin no. 10.)

JORDAN, G. GUNBY. Material and moral benefits of industrial education. *In* National society for the promotion of industrial education. Proceedings, 1908. p. 122–33. (*Its* Bulletin no. 9.)

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[MICHIGAN. UNIVERSITY. ENGINEERING SCHOOL. Statistics concerning the success of its graduates.] American educational review, 31: 492, May, 1910.

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New Jersey. Commission on industrial education. The money value of industrial training. *In its* Report. Trenton, N. J., MacCrellish & Quigley, 1909. p. 33–38. chart. (Appendix C.)

O'Leary, Wesley A. The wage value of vocational training. New York state factory investigating commission, Albany, 1915. 4th report. Appendix, VI. p. 1407–60.

Contains a large amount of valuable concrete data on the influence of a number of industrial schools upon the salaries of their pupils.

New York vocational school for boys. Report of the principal, 1911–12.

Gives salaries received by graduates.

Person, Harlow Stafford. Efficiency of industrial education indicated by experience. *In his* Industrial education. Boston and New York, Houghton Mifflin company, 1907. p. 27–36.

Pratt institute, Brooklyn, N. Y. School of science and technology. Occupations and salaries of graduates of the School of science and technology. *In its* Alumni directory, 1914., p. 74–77.

Rochester, N. Y. Board of education. Report, 1913.

Gives earnings of trade graduates as compared with others who left school.

Rice, D. E. Study of incomes of technically trained men. Scientific American, 109 : 116, August 9, 1913.

Rollins, Frank. [Average wages of boys shop-trained and trained in technical schools.] *In his* Industrial education and culture. Schoolmasters' association of New York and vicinity. Monthly report, 15 : 6, November, 1907.

Vanderlip, Frank A. The economic importance of trade schools. *In* National education association. Journal of proceedings and addresses, 1905. p. 141–2.

Discusses the question in general and in specific relation to German progress.

HIGHER EDUCATION.

Annual incomes of a recent Yale class. Yale alumni weekly, 21 : 444–45, January 19, 1912.

Statistics from the Five year record of the class of 1906, showing the average incomes of the men for each of the years since graduation.

Partly republished under title "Does college education pay?" in Chautauquan, 66 : 158–60, April, 1912; also in Literary digest, 44 : 212–13, February 3, 1912.

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Chairman, Susan M. Kingsbury.

Statistics regarding living expenses and incomes.

Barker, John Marshall. The practical value of an education. *In his* Colleges in America. Cleveland, Ohio, Cleveland printing and publishing co., 1894. p. 196–228.

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Does a college education pay? American educational review, 30 : 339–41, May, 1909.

Draper, E. G. The college man in business. Outlook, 106 : 27–30, January 3, 1914.

Educational values. Dial, 55 : 10, July 1, 1913.

Gives the results of some computations made by the Northwestern university. Claims that a college diploma is worth $25,000.

Fellows, S. N. Practical value of a college education. *In* National education association. Journal of proceedings and addresses, 1885. p. 214–22.

Flint, Charles R. Is a college education advisable as a preparation for a business career? Address . . . Outlook club of Montclair, N. J., November 23, 1900. 14 p.

Gault, F. B. The social and civil value of higher education. *In* South Dakota educational association. Proceedings, 1906. p. 72–80.

Hapgood, E. J. College men in business. Annals of the American academy of political and social science, 28: 58–69, July, 1906.

Hazen, Charles Downer. The college and the citizen. American educational review, 33: 122–30, December, 1911.

Gives the value of a college education.

Hyde, William DeWitt. The earnings of college graduates. *In his* The college man and the college woman. Boston [etc.] Houghton Mifflin company, 1906. p. 219–23.

Tables showing earnings of graduates of Bowdoin college, by decades, 1 to 60 years out of college.

Jones, J. C. The success of the college graduate. *In* Southern educational association. Proceedings, 1899. p. 73–84.

College graduates among Congressmen.

——————. Does college education pay? Forum, 26: 354–63.

Shows per cent of college men in prominent public positions.

Kratz, H. E. College education—does it pay? Educational review, 17: 297–99, March, 1899.

Miller, Herbert Adolphus. Incomes of college graduates ten years after graduation. Science, n. s. 31: 199–200, February 4, 1910.

Pay of college graduates. School bulletin, 35: 47–48, November, 1908.

Salaries statistics, college graduates.

From Boston herald.

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An account of the introduction of insects that preyed upon the enemies of trees and field crops.

Person, Harlow S. The college graduate in trade and industry. Education, 27: 589–600, June, 1907.

Princeton university. Class of 1901. Individual incomes. *In its* Decennial record. [Princeton] 1912. p. 343–47.

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The value of an education to the individual. Does it "pay" to go to college? Christian student, 17: 66–68, May, 1916.

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With statistics.

——— College training and the business man. North American review, 177: 587–669, October, 1903.

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CAMPBELL, P. L. Education and the state. *In* Lewis and Clark educational congress, Portland, Oreg., 1905. [Portland, Oreg., Presses of Anderson & Duniway co.] p. 113–21.

CARLTON, FRANK T. The industrial factor in social progress. *In* National education association. Journal of proceedings and addresses, 1910. p. 659–66.

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CLAXTON, PHILANDER PRIESTLEY. The economic value of education. *In* Maryland state teachers' association. Proceedings, 1912. p. 29–36.

——— Education and material wealth. *In* Missouri state teachers' association. Proceedings, 1912. p. 96–109.

——— Education and wealth. *In* Wisconsin teachers' association. Proceedings, 1910. p. 185–88.

DABNEY, CHARLES W. Ratio of education to production. World's work, 1: 587–88, April, 1901.

———. A world wide law. *In* University of Tennessee. Index, series II, no. 10.

Shows that the producing power of the citizens of a state is in proportion to amount of education given them.

ELLIS, A. CASWELL. The relation of education to economic development. Texas school magazine, 12: 5–8, November, 1909.

——— The relation of higher education to the economic development of the state. Journal of education, 76: 199–201, August, 1912.

FERNALD, R. F., *and* SMITH, C. D. Résumé of producer-gas investigations, October 1, 1904–June 30, 1910. U. S. Bureau of Mines. Bulletin, 13.

Gives an account of the savings made possible by producer-gas engines.

FISHER, IRVING. Conservation of human life. United States 62nd. congress, 2nd. session. Document, 493.

Shows the financial losses from disease and the enormous savings brought about by medical science.

——— Economic aspects of lengthening human life.

Similar to the article above.

——— Report on national vitality. Committee of one hundred on national health. Bulletin, no. 30.

Similar to the first-mentioned article.

FRANKEL, LEE K. Conservation of life by life companies. Reprinted from the Insurance world, August 12, 1913.

Shows great money value of medical science.

GROSER, W. P. Education and industrial success: report on the relations of education and industry in the United States of America. London, 1905. 32 p. 8°.

HOFFMAN, F. L. Chances of death and the ministry of health.

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HOWARD, L. O. Recent progress and present conditions of economic entomology. *In* Seventh international zoological congress. Proceedings.

Shows money saved by economic entomology.

Information regarding the study and investigation of the boll weevil and hog cholera plagues. United States. 63rd. Congress, 2nd. session, December, 1913. Document, 463.

Shows great money savings from application of scientific knowledge to these two problems.

Iowa's campaign for better corn. Review of reviews, November, 1904, p. 563, *and* December, 1908, p. 714.

Jenks, Jeremiah W. The social basis of education. *In his* Citizenship and the schools. New York, Henry Holt and company, 1906. p. 39–73.

Lapp, John A. [Value of scientific training for modern industry.] Case and comment, September, 1913. p. 234.

Marschal, Paul. The utilization of auxiliary entomophagous insects. Popular science monthly, 1908, p. 364.

Gives concrete cases of great money losses prevented by applying knowledge of entomology.

National education association. Committee on taxation as related to public education. Report. Published by the association, 1905.

National society for the promotion of industrial education. Bulletin no. 1.

This gives the address of Sir Norman Lockyear on "Brain power in history."

Poe, Clarence H. Asia's greatest lesson for the south.

Shows the value of education and of tools in increasing production.

Porritt, Edward. Civic value of 400 college graduates in Hartford, Conn. Independent, 58: 1163–68, May 25, 1905.

Potts, Charles S. Texas cattle fever: how science is winning a long fight. American review of reviews, 29: 49.

Reports valuable results of work on cattle tick fever in the south.

Reynolds, John H. The relation of education to production. Fayetteville, Ark. [1905]. 15 p. 8°.

Schaeffer, Nathan C. Taxation for school purposes. *In* National education association. Journal of proceedings and addresses, 1902. p. 314–23.

Contains arguments showing that public money spent on education is well invested.

Scope and results of the work of the college of agriculture. University of Wisconsin. School of agriculture. Manuscript report of the Dean.

Small, R. O. [The value of education to a community.] *In* United States. Bureau of education. Special features in city school systems. Washington, Government printing office, 1913. p. 19–20. (Bulletin, 1913, no. 31.)

Report made by the Superintendent of schools of Beverly, Mass., giving figures showing the economic value to the community of a boy who has been graduated from the Beverly schools.

Thompson, William Oxley. The economic relations of education. *In* National education association. Journal of proceedings and addresses, 1907. p. 87–93.

Young, J. T. Business and science. *In* Annals of the American academy of social and political science, 28: 28–37.

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Wisconsin university. [Account of the discoveries made and practices taught by the University of Wisconsin that have brought great financial returns to the state.] Bulletin, no. 666. General series, 478.

Work and needs of the agricultural college and experiment station of the University of Illinois. Illinois printing company, December, 1908.

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DEPARTMENT OF THE INTERIOR
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THREE SHORT COURSES IN HOME MAKING

By CARRIE ALBERTA LYFORD

SPECIALIST IN HOME ECONOMICS, BUREAU OF EDUCATION

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THREE SHORT COURSES IN HOME MAKING.

INTRODUCTION.

The three brief courses in home making outlined in this pamphlet have been especially prepared for use in the elementary rural schools. They are in no sense a complete outline of the subjects with which they deal; rather, they indicate a few of the important phases of food study, sewing, and care of the home with which the girl in the elementary school should become familiar. The underlying thought for each problem should be, "Will this help the girls to live more useful lives and will it lead to better conditions in their homes?"

The lessons are purposely made simple, and the plans are definitely outlined, so that the inexperienced teacher will be able to get her problem well in hand. The experienced teacher may find in them suggestions that will be of value in the further development of her course.

The lessons were originally planned for use in the rural schools of the South.[1] During the six months that they have been in use, however, the demand for copies of the outlines has been almost equally great from all parts of the country; hence, in so far as possible, general problems have been stated. In any case the teacher who desires to use the course will necessarily have to adapt it to her own community, and it is hoped that she may be able to do this with but little alteration. While conditions of living and choice of foods differ in the various parts of the country, general principles of nutrition, rules of sanitation, and methods of cooking and serving are the same for all.

Because of the short school year in some rural schools and the difficulty of securing time on the program for frequent lessons in home making, each of the courses has been limited to 20 lessons. Some teachers may not be able to have a greater number of lessons during the school year, and they will find it well to carry the three courses through three successive years. In other schools where more frequent lessons can be given it may be well to offer all three of the courses during one year. The courses in cooking and the care of the home can be combined to advantage, as many of their problems are related. The lessons in sewing can be given on another day of the week or it may be well to have them given early in the year and followed later in the year by the cooking lessons. Thus opportunity will be furnished for the making of the cooking apron and the hemming of the towels.

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[1] The original outlines were prepared in response to requests received from southern State supervisors.

It is most desirable that periods of at least 40 minutes be provided for all of the practical lessons. Longer periods will be necessary for some of the lessons, such as the preparation and serving of a meal. If no practical work is undertaken in the lesson, a 30-minute period is sufficient.

A HOME-ECONOMICS LIBRARY FOR THE RURAL SCHOOL.

In addition to the textbooks listed as sources of special reference for the rural teacher, the following books bearing on home economics or on methods of teaching are suggested for the rural-school library. They have been chosen with the threefold purpose of providing references for the teachers, reading matter for the pupils, and a loan library for the parents.

Balderston, L. Ray—"Laundering." Price, $1.25. Published by the author. Philadelphia.

Carney, Mabel—"Country life and the country school." Price, $1.25. Row, Peterson & Co., Chicago.

Carpenter, F. O.—"Food, or how the world is fed." Price, 60 cents. American Book Co., New York City.

———, ——, —"How the world is clothed." Price, 60 cents. American Book Co., New York City.

———, ——, —"How the world is housed." Price, 60 cents. American Book Co., New York City.

Chamberlain, J. F.—"How we are clothed." Price, 40 cents. The Macmillan Co., New York City.

———, ——, —"How we are fed." Price, 40 cents. The Macmillan Co. New York City.

———, ——, —"How we are sheltered." Price, 40 cents. The Macmillan Co., New York City.

Conn, H. W—"Bacteria, yeasts, and molds in the home." Price, $1.20. Ginn & Co., Boston.

Cooley, Anna M.—"Domestic Art in Women's Education." Price, $1.25. Scribners New York City.

Dewey, John.—"The School and Society." Price, $1. The University of Chicago Press, Chicago.

Farmer, Fannie M.—"The Boston cooking school cook book." Price, $1.80. Little, Brown & Co., Boston.

Farnsworth, N. W.—"The Rural School Lunch." Price, 25 cents. Webb Publishing Co., St. Paul.

Field, Jessie, and Nearing, Scott.—"Community Civics." Price, 60 cents. The Macmillan Co., New York City.

Hutchison, Robert.—"Food and Dietetics." Price, $3. William Wood & Co., New York City.

Hough, T. H., and Sedgwick, W. T.—"Human Mechanism." Price, $2.40. Ginn & Co., Boston.

Kinne, Helen, and Cooley, Anna M.—"Clothing and Shelter." Price, $1.10. The Macmillan Co., New York City.

———, ——, —"Foods and Household Management." Price, $1.10. The Macmillan Co., New York City.

Lynch, C.—"American National Red Cross Textbook." Price, 30 cents. Blakiston, Philadelphia.

Maxwell, A. C., and Pope, A. E.—"Practical Nursing." Price, $1.75. Putnam, New York City.

Ogden, Henry Neely.—"Rural Hygiene." Price, $1.50. Saunders, Philadelphia.

O'Shea, M. V., and Kellogg, J. H.—"Health and Cleanliness." Price, 55 cents. The Macmillan Co., New York City.

Pickard, A. E.—"Rural Education." Price, $1. Webb Publishing Co., St. Paul.

Pyle, Walter L.—"Manual of Personal Hygiene." Price, $1.50. Saunders, Philadelphia.

Richardson, Bertha J.—"The Woman Who Spends." Price, $1. Whitcomb & Barrows, Boston.

Rose, Mary S.—"Food for the Family." Price, $2.10. The Macmillan Co., New York City.

Sherman, Henry Clapp.—"Food Products." Price, $2.25. The Macmillan Co., New York City.

TWENTY LESSONS IN CARE OF THE HOME.

For the Rural Schools.

OUTLINE OF THE COURSE

Lesson I. Arrangement and care of the kitchen.
Lesson II. Care of cupboards and utensils.
Lesson III. Care of food: Methods of keeping, storing, and handling.
Lesson IV. Disposal of waste. Care of garbage. Disposal of dish water. Protection of water supply Care of out-door closet. Simple disinfectants.
Lesson V. Making soap.
Lesson VI. Setting the table.
Lesson VII. Waiting on table.
Lessons VIII and IX. General cleaning of a room.
Lesson X. Care of bedroom. Ventilating and cleaning bedroom; making beds.
Lesson XI. Care of lamps.
Lesson XII. Prevention of pests.
Lesson XIII. Removing stains, bleaching fabrics, and setting colors.
Lesson XIV. Washing dish towels, school curtains, etc.
Lesson XV. Ironing.
Lessons XVI and XVII. Care of the baby: Food, sleep, clothing, and bathing.
Lesson XVIII. Cost of food, clothing, and house.
Lesson XIX. How to keep accounts.
Lesson XX. Care of the exterior of the house.

SUGGESTIONS TO THE TEACHER.

The purpose of the course entitled "The Care of the Home" is to give the girls instruction in the various household tasks, in order that better living conditions may be secured in the homes. The beauty and sacredness of home life should receive emphasis, so that the girls may feel the importance of conscientious work in the performance of their daily household duties. The girls should have some insight into the sanitary, economic, and social problems that are involved in housekeeping, so that they may develop an increased appreciation of the importance of the home maker's work.

The two most important things to be taught are "cleanliness and order." Too much emphasis can not be put on the value of fresh air and sunshine and the necessity for free use of hot water and soap. The value of property must be emphasized. Economy in the purchase and handling of house furnishings and equipment must be considered. Instruction should be given in the care and arrangement of furniture and in the care of foods and clothing. Simple instruction in the care of babies should be given, since the children are generally responsible for the care of the younger members of their families.

In some of the lessons more subjects may be suggested than the teacher will have time to take up in a single period. In that case it will be well for her to choose the subject which seems most vital to the immediate needs of the community. In many cases she may be able to give an increased number of lessons. Practice and drill in all of the processes involved in housewifery are essential to successful training.

If a cupboard and table have been arranged for the use of cookery classes, most of the suggested work can be carried out with the school equipment. Where equipment is not at hand in the school, and school conditions do not approximate home conditions, it may be possible to secure permission to give the lesson in a near-by home of one of the girls after school hours.

In each lesson the teacher should strive to impress the girls with the importance of doing some one simple thing well, giving them helpful information in regard to the subject that will be of value to them in their own homes.

The rural teacher who is eager to make her schoolroom an attractive place can devote some time in these lessons to such problems as the hanging and care of simple curtains; the care of indoor plants; the arrangement of pictures; the planning of storage arrangements for supplies and of cupboards for dishes; and the preparations for the serving of the school lunch.

It will be desirable for the rural teacher to have the following simple equipment on hand in order to teach these lessons effectively. Additional special equipment can be borrowed from the homes.

EQUIPMENT.

Broom, 1.
Cloths for cleaning, 6.
Dish cloths, 2.
Dish towels, 12.
Dust brush, 1.
Dust pan, 1.
Garbage can (covered), 1.
Lamp, 1.
Oil can, 1.

Southern teachers can obtain the following helpful bulletins from Hampton Institute, Hampton, Va., upon request:

Hampton Leaflet; Vol. II, No. 9, Housekeeping Rules.
Hampton Leaflet; Vol. VI, No. 2, Housekeeping and Sanitation for Rural Schools.
Hampton Leaflet; Vol. VI, No. 9, Housekeeping and Cooking Rules for Rural Communities.

CARE AND SANITATION OF THE HOUSE.

A suggestive list of texts and reference books for use in elementary rural schools.

Brewer, I. W.—"Rural Hygiene." Price, $1.25. Lippincott Co., Philadelphia.
Dodd, Helen.—"The Healthful Farmhouse." Price, 60 cents. Whitcomb & Barrows, Boston.
Hutchinson, Woods.—"Community Hygiene." Price, 60 cents. Houghton Mifflin Co., Boston.
Forster, Edith H., and Weigley, Mildred.—"Foods and Sanitation." Price, $1. Row, Peterson & Co., Chicago.
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DETAILED LESSON PLANS FOR THE COURSE IN "THE CARE OF THE HOME."

LESSON I. ARRANGEMENT AND CARE OF THE KITCHEN.

SUBJECT MATTER.

In arranging the kitchen the three things of most importance are the stove, the sink, and the kitchen table. If there is no sink in the kitchen, there will be some other place arranged for washing the dishes, probably the kitchen table, and this must be taken into consideration when the furniture is placed. As most of the work of the kitchen is done at the stove and the table, these must both be placed where they will have a good light and be near enough to one another so that but few steps are necessary for the worker. All the furniture should be kept so clean and free from dust that the kitchen will have a neat and attractive appearance. A bit of green, a potted plant, a neat rug, and a wash table cover, to be put on the table after the dishes have been washed, will help to make the kitchen a pleasant place for the family.

The kitchen should be thoroughly cleaned after each meal. If it has become dusty or disarranged before the next meal is prepared, it should be put in order before beginning to work with the food. While the cooking is under way everything should be kept in orderly condition. Just as soon as the meal is completed the left-over food should be covered and put away to keep; scraps and trash should be gathered up and disposed of; dishes, pots, and pans should be scraped and washed in hot soapy water, then rinsed in clear, hot water, dried, and put away. The table should be scrubbed, the stove cleaned, the floor swept and scrubbed whenever necessary, and everything put neatly in its place.

Care of coal or wood range.—All spots should be kept off the range by wiping with old paper. The range should be washed off with soap and water if it is in bad condition. If it is oiled occasionally, blacking will not be necessary. If blacking is used, it should be applied with a cloth and rubbed to a polish with a brush just as the fire is being started. Once a week the ashes and soot flues back of the oven and under it should be cleaned out.

Directions for building a fire.—To build and care for a fire in the coal and wood range, close all dampers, clean the grate, and remove ashes from the pan. Put on the covers and brush the dust off the stove. Open the creative damper and the oven damper; leave the check closed. Lay some paper, slightly crumpled into rolls, across the base of the grate. Lay small pieces of kindling wood across one another, with the large pieces on top. Lay pieces of hardwood or a shovelful of coal on top, building to admit of free circulation of air. If the stove is to be polished, rub it with blacking. Light the paper from below. When the fire begins to burn briskly, add coal or wood; then add more when that kindles. When the fire burns briskly, and blue flame is no longer seen (about 10 minutes), close the oven damper. Close the draft as soon as the fire is sufficiently hot. Brush the stove and floor beneath as soon as the fire is started. Polish the stove. If the fire becomes too hot, open the check. Fill the tea-kettle with fresh water and set it on the front of the range.

PRELIMINARY PLAN.

It will be well to have this lesson succeed or follow a cooking lesson, for then the girls will have a keener interest in the problems of the kitchen.

(See Twenty Lessons in Cooking, Lesson I.)

METHOD OF WORK.

Cleanliness and order are the two points to be considered in this lesson. The doing well of each simple household task and the thoughtful arrangement and planning of all parts of the house should be emphasized as of great importance to the housekeeper's success.

Begin the lesson with a discussion of the purpose of the kitchen; then discuss its arrangement from the standpoint of convenience for the work that must be done there. Emphasize the importance of having the furniture so arranged that work can be done quickly and easily, and that the kitchen be given a comfortable and attractive appearance. Have the girls arrange the furniture in the schoolroom. Discuss and demonstrate the care of the stove by use of the school stove. Assign each girl a time when she is to look after the stove on succeeding days and grade her on her work. Have each girl bring a report from home as to what she is doing to help in the care of the home kitchen. Make a specific assignment for home work.

QUESTIONS USED TO DEVELOP THE LESSON.

What is the purpose of the kitchen?
What are the principal articles of furniture in the kitchen?
What must be kept in a kitchen besides furniture?
How should we arrange these things?
Can we make any general rules as to arrangements?
Why is it difficult to keep the kitchen clean?
At what times is the kitchen most apt to become disarranged?
Why is it important to keep the kitchen in good order?
In what order should the kitchen be at the time we begin the preparation of the meal?
How should the floor be cleaned? The utensils? The air?
How should we take care of the kitchen during the meal?
What should we do with any left-over food?
How should we take care of the stove after the meal?

LESSON II. CARE OF CUPBOARDS AND UTENSILS.

SUBJECT MATTER.

It is of the utmost importance that cupboards and other places where food is stored be kept free from dirt and scraps of food. Ants, cockroaches, mice, and other pests infest dirty places where food is kept, and render a house unfit for human habitation. It requires constant care and watchfulness on the part of the housewife to keep cupboards clean. She must look over the shelves daily, wiping them off whenever they need it and giving them a thorough cleaning at least once a week.

The housekeeper should know how to care for the various utensils and understand the simplest and best methods of keeping them clean. Utensils should never be put in the cupboards until perfectly clean and dry. If utensils have become discolored or badly coated with materials, they should be specially scoured when the dishes are washed. If something has been burned in a kettle, the kettle can be cleaned by filling with cold water, adding washing soda, and boiling briskly for half an hour; after that a slight scraping ought to take the burned portion off. If not, it should be boiled again with soda water. If a kettle has been used directly over a wood fire and becomes blackened with soot, it should be rubbed off with newspaper and then with an old cloth. Kettles should be dried well before putting away. With proper care they seldom become rusty. If an iron kettle has rusted, it can be rubbed with kerosene and ashes, then washed in strong, hot, soda water, rinsed in clear hot water, and dried on the stove. If a kettle is very rusty, it should be covered thoroughly with some sort of grease, sprinkled with lime, and left overnight. In the morning it should be washed out with hot soda water and rinsed in clear, hot water. A new kettle is generally rusty, and should be greased thoroughly inside and out and let stand two days; then washed in hot soda water.

Soft chimney brick can be used for scouring iron utensils and steel knives and forks. If iron pots and frying pans are scrubbed with a piece of soft chimney brick each time they are used and then washed in hot soapsuds, they can be kept in good condition. Tinware and steel knives and forks can be cleaned by scouring with ashes. Only fine ashes should be used on tinware. The brown stains on granite saucepans should always be scoured off. Coffee and tea pots should be cleaned daily, the grounds removed, and the interior of the pots washed out thoroughly. The tea kettle should be washed and dried out over night and left open to air.

PRELIMINARY PLAN.

If school lunches are served or cooking lessons given at the school, it will be well to use the lesson to get the cupboards in readiness. If it is impossible to do this at school, arrange to have such a lesson in one of the homes outside of school hours. Be sure that the housekeeper is in sympathy with the work and will cooperate with the plans.

METHOD OF WORK.

Assign each girl a task in the cleaning, scouring of the dishes, and arrangement of the cupboard. Set a definite amount to be done and carry out the plans, leaving a clean and neatly arranged cupboard at the end of the lesson.

LESSON III. CARE OF FOOD.

SUBJECT MATTER.

There are several points of importance that must be borne in mind if food is to be kept in good condition. Most foods change easily. Vegetables and fruits lose water, wilt, and become unfit to eat. Flour and corn meal become moldy. Potatoes decay and sprout. Some foods, such as milk, turn sour. Eggs become tainted and butter grows rancid. This spoiling can be prevented with proper care in the handling, storing, and keeping of foods.

The spoiling of food is due to the presence of microorganisms. If foods are fresh and sound and kept cool and clean in every way, spoiling will not take place readily, because the microorganisms will not develop. If the food is roughly handled and bruised, decomposition will take place readily, for microorganisms develop in the bruised portions. Care must therefore be taken to select food wisely, handle it carefully, wash it if it is not already clean, put it in clean receptacles, and keep it in a clean, cool place. All pots, pans, and dishes in which foods are kept or cooked should be thoroughly cleansed and rinsed well, so that no fragments of food stick to them to decay and to cause possible infection to the next food that is put in Every part of the kitchen and storerooms should be kept clean, dry, and well aired. Light is the best germicide and purifier known.

Covered receptacles should be secured for all foods. Those that are mouse proof and insect proof are essential to a well-kept pantry. All bottles and cans should be neatly labeled and so arranged that each one can be conveniently reached. The outside of the bottle or case should always be wiped off after it has been opened and food has been removed from it. The shelves on which food cases are kept should be wiped off every day. If a supply of fruit or vegetables is kept on hand, the food should be looked over frequently, and any that shows even the slightest suggestion of spoiling should be removed. Bread should be kept in a covered tin box, the box washed out once or twice a week, and frequently aired.

PRELIMINARY PLAN.

If cooking lessons are to be given, it will be well to have this lesson in connection with the first lesson and to make it a means of arranging for the materials that are to be kept on hand and of determining how everything is to be handled.

METHOD OF WORK.

Devote a large portion of the lesson to a discussion of the necessity for care in the handling, storing, and keeping of food. If facilities permit, devote a few minutes to the putting away of foods that are to be used in the next cooking lesson or school lunch, discussing the reasons for such care.

LESSON IV. DISPOSAL OF WASTE.

SUBJECT MATTER.

If one looks after the daily disposal of waste, there will be no offending accumulation of trash. Scraps of food that can be no longer utilized for the table can be fed to the pigs or chickens, but they should not be allowed to stand around and gather flies. A covered pail or pan should be used for holding the garbage until final disposal is made of it. Those portions of waste that are badly spoiled and will be of no value in feeding the stock should be burned up at once. Piles of waste vegetable substances, if suitable, should be fed to the stock, and if not, should be buried in a thin layer on the ground at some distance from the house so that they may enrich the soil and not attract flies.

Utensils that have held food should be thoroughly washed and rinsed with hot water or steam in order to prevent particles of food from adhering and becoming spoiled. Milk bottles and pans should always be thoroughly sterilized with boiling water or steam after they have been washed. The garbage can should be boiled with water and soda each day and rinsed with hot water in order to keep it sweet and clean.

Old papers that are badly soiled should be burned, but all others should be kept for use in cleaning the stove, starting fires, etc. Empty cans should be well washed and buried, so that they will not prove a breeding place for flies. It is well to pierce them through the bottom immediately after opening them so that they will not hold water. If not convenient to bury the cans, they should be burned up. Dishwater should be emptied some distance from the house unless there is a drain near the house. All receptacles that hold water should be carefully emptied and all depressions in the soil should be filled up to prevent mosquitoes. All waste water can be used on the garden.

Protection of water supply.—Only water from deep wells should be used for drinking purposes, because all surface water and water in shallow wells becomes dangerous through seepage from compost, pigpens, privies, and other places where decayed organic matter is accumulated. In order that the water be kept clean, the well must be supplied with a tight-fitting top, which need not be opened, and a metal pump to bring up the water. A well platform that allows water spilled on it to run back into the well is unsafe, for any filth carried on to the platform in any way will be washed directly into the well. Rats, mice, and other animals get into the well if the top is not tight, and these, in addition to being unpleasant, are liable to carry germs.

Simple disinfectants.—Sunshine and fresh air are nature's disinfectants, and should be freely admitted to every part of the house. Windows should be left open whenever possible. The windows in sleeping rooms should always be opened at night. The interior of the house should be kept perfectly dry. Decay does not take place in dry places that are well aired. A damp cellar should be drained off, and the grounds around the house should be prevented from draining into the cellar. Coarse coal ashes should be used to fill in around the house, on the walks, etc., to help secure thorough drainage. The fine ashes should be thinly scattered over the vegetable garden in order to restore the valuable properties they contain to the soil. Wood ashes can be used as a simple disinfectant to cover decayed organic matter. Whitewash is a good disinfectant and should be frequently used both inside and outside the house and on all outbuildings. Slacked lime is valuable as a disinfectant for use in the cellar or barn lot. Kerosene and creoline also make good disinfectants for frequent spraying of the barn lot.

Care of out-of-door closets.—The privy should be so arranged that it may be cleaned often and all excreta disposed of in a safe way. The building should be so well built that there will be no cracks for the constant admission of flies. In a poorly constructed building, old paper can be pasted in the cracks to make the structure fly proof. After each using dry earth, street dust, or lime should be sprinkled through the seat, then the seat should be closed to prevent flies or mosquitoes entering. The top of the seat should be frequently washed, and both the seat and the floor in front of it scrubbed at least once a week.

PRELIMINARY PLAN.

It will be well to teach this lesson at a time when improvements are necessary in the care of the schoolhouse. The discussions in regard to out-of-door closets will have to be taken up at a time when the girls are alone with the teacher.

METHOD OF WORK.

Discuss the disposal of waste, the care of garbage, etc., for the home and for the school. Talk over the care of waste from the school lunch and discuss methods of keeping the school in sanitary condition. Follow this by general cleaning about the schoolhouse.

LESSON V. MAKING SOAP.

SUBJECT MATTER.

HOMEMADE HARD SOAP.

6 pounds fat.	1 pint of cold water.
1 can lye.	1 tablespoon borax.

Melt the fat slowly. Mix lye and water in a bowl or kettle (do not use a tin pan), stirring with a stick until the potash dissolves. Add the borax and allow the mixture to cool. Cool the fat and when it is lukewarm add the lye, pouring it in a thin stream and stirring constantly. Stir with a smooth stick until about as thick as honey and continue stirring 10 minutes. Pour the mixture into a box and allow it to harden. Cut into pieces the desired size and leave in a cool, dry place for 10 days, to ripen before using.

When making the soap be careful not to spatter potash or lye on the hands, as it makes a bad burn. If hands are burned with lye, rub with grease at once. Do not wet them.

PRELIMINARY PLAN.

Some time before this lesson is given ask the girls to bring scraps of fat from home. See that these are in good condition, and weigh them to determine the portion of the recipe that can be made. Ask if one of the girls can bring sufficient borax for the recipe.

METHOD OF WORK.

Have the girls look the fat over and put it on to melt, watching it carefully. While it is heating and cooling, discuss the process of soap making, cost of materials, care necessary in the making of soap, and importance of its use. Get the other materials ready for the recipe and a box for molding the soap, and have the girls work together. After the soap has hardened and been cut, have the girls put it away on a shelf to dry.

LESSON VI. SETTING THE TABLE.

SUBJECT MATTER.

Points to be remembered when a meal is to be served: The dining room must be clean, free from dust and flies, well aired, sufficiently lighted, and in good order.

The table must be perfectly clean and covered with a clean white cover (tablecloth, doilies, paper napkins, or oilcloth).

A vase of flowers or leaves, or a small potted plant, arranged in the center of the table, will help to make the table attractive.

The table should be prepared with everything necessary for serving the meal, but only those foods placed on it that will not be spoiled with standing. If there is danger of the food attracting flies, cover it carefully.

Plates for everyone who is to partake of the meal should be arranged at equal distances from one another, half an inch from the edge of the table.

The knife should be placed at the right of the plate with the cutting edge toward the plate and half an inch from the edge of the table.

The fork should be placed at the left of the plate with the tines of the fork turned up and half an inch from the edge of the table.

The spoon should be placed, bowl upward, at the right of the plate, to the right of the knife if it is to be used first, to the left of the knife if it is not used until after the knife is used. It should be placed half an inch from the edge of the table. Spoons and forks for serving should be placed at the right of the one who is to serve. No one at the table should have to use the personal fork or spoon for serving either herself or others.

The napkins should be simply folded and placed at the left of the fork.

The tumbler should be placed at the upper end of the knife.

Cups and saucers should be placed at the right of the plate with the handle of the cup turned to the right.

The individual butter dish, if used, should be placed at the upper left hand of the fork.

Salts and peppers should be placed in the center of the table or at the sides where they can be conveniently reached. Individual salt dishes, if used, should be placed immediately in front of the individual plate.

The chairs should be placed up to the table after it is set. Care should be taken not to place them so close that it will be necessary to move them when they are occupied.

PRELIMINARY PLAN.

If possible, arrange to give this lesson before Lesson VIII in the series of "Twenty Lessons in Cooking" is given; then the emphasis in that lesson can be put upon what to serve, proper combinations, etc., while this lesson gives the drill in the arrangement and handling of dishes.

It is desirable to give the girls thorough drill in table setting and table service, since much of the pleasure derived from eating foods depends upon careful attention to these processes.

Be careful to see that everything necessary is on hand to set the table nicely but simply. For class practice a small table can be set for four. This will necessitate a table cover, five or more dinner plates, four butter dishes or plates, four tumblers, four cups and saucers, four knives, four forks, four teaspoons, four napkins, a salt dish, a platter, one serving spoon, and one serving fork. If these things are not already in the school, they can probably be brought from home by the girls. If linen cloths are not used and can not be afforded in the homes, the girls can be taught to use a sheet of white oilcloth on the table.

Have a diagram of the arrangement of an individual place at the table made on the blackboard by some of the girls.

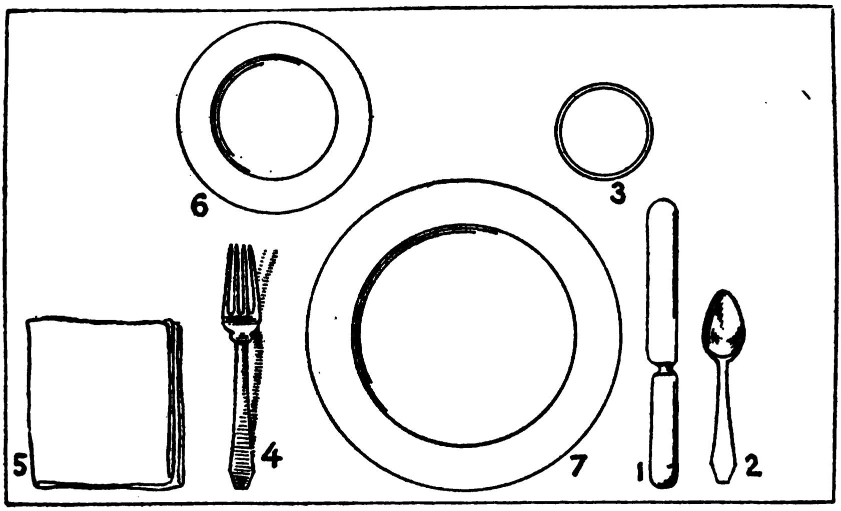

FIG. 1.—Arrangement of an individual place at table.
(Adapted from Conley, "Principles of Cooking.")
1. Knife. 2. Spoon. 3. Water glass. 4. Fork. 5. Napkin. 6. Bread-and-butter plate. 7. Dinner plate.

METHOD OF WORK.

The processes of table setting should be demonstrated with the materials at hand and the work should be adapted to home conditions.

If there is no available table in the schoolroom, the desk tops can be used for individual places.

Reasons for all the forms used should be given—the convenience of placing knives and spoons to the right, forks to the left, and the cup and saucer and tumbler to the right, the use of the napkin, etc.

LESSON VII. WAITING ON TABLE.

SUBJECT MATTER.

The person who is to wait on table must be careful to see that everything is in readiness before the meal is announced, so that she can do her work readily without subjecting those at the table to delay. She should have drinking water, bread, and butter (if used) at hand, hot dishes ready for the hot foods, and clean dishes laid out for the dessert. She must see that her own hands are perfectly clean and her hair and dress in order. A clean, neat apron will always improve her appearance. The room should be clean and neatly arranged before the meal is served.

If the meal is to be a family one and all are to sit down at the table together, plates will be passed from one to another as they are served, but it will still be well to have one person appointed to wait on the table. She can keep watch and be ready to supply more bread, water, etc., when it is necessary and to change the plates for the dessert course. She should rise from the table quickly and quietly in order not to disturb the others and should take her place again as soon as all necessary service has been rendered.

The following rules should be observed: Always handle tumblers from the base, being careful not to bring the hands in contact with the upper edge. Fill only three-fourths full.

Serve butter in neat, compact pieces. Put on the table just before the meal is served.

Cut bread in even slices, pile neatly on serving plate, and place on table, covering with a clean napkin or towel if flies are bad or there is danger of dust. Place dessert dishes at one end of the table, or better still on a side table until time to use them. When carrying dishes to and from the table be careful not to put the fingers in contact with the food. Learn to place the hand under the dish. In nice service a napkin is used between the hand and the dish or a tray is used if the dish is a small one. The tray should be covered with a napkin or doily.

When a dish is passed, hold it at the left of the person to be served low enough so that she can help herself readily. Be sure that each dish of food is supplied with a spoon or fork for serving, and turn the handle of the serving spoon or fork toward the one being served.

If a plate is to be placed in front of a person, set it down from the right and remove it from the right. Never reach in front of others at the table.

When a course is finished remove all large dishes first; then the soiled plates, knives, and forks. Be careful to handle only a few dishes at a time and not to pile them. If another course is to be served, crumb the table, using a napkin and plate for the purpose and brushing the crumbs lightly into the plate. Fill the glasses and arrange the dishes and forks or spoons quickly for the next course.

When the meal is over the chairs should be moved back from the table, the dishes neatly piled and carried to the kitchen sink, the table wiped off, the crumbs brushed up from the floor, and the room aired.

PRELIMINARY PLAN.

Let this lesson be a continuation of the previous one, putting emphasis on the method of waiting on table. The same articles for setting the table will be required that were in use in the last lesson. In addition to these the girls must be careful to have clean aprons for the lesson on table service.

METHOD OF WORK.

Have the table set as a review of the work of the last lesson; then have four or six of the girls seated at the table and go through the forms of serving one another to any simple meal upon which the class may decide. Family meal service should be explained and demonstrated first; then service where there is one waitress. Have one girl act as waitress and serve all the others. Let them take turns in offering and placing food, removing soiled dishes, filling tumblers, etc.

LESSONS VIII AND IX. GENERAL CLEANING OF A ROOM.

SUBJECT MATTER.

Rooms which are in constant use should be brushed up and dusted every day. A thorough cleaning of each room in the house will be necessary every week or two, even though the room is brushed up and kept in order every day. First, all closets, drawers, and other receptacles in which articles collect should be cleaned; then all large movable articles should be dusted and moved out of the room; those that are not readily movable should be dusted and covered. The floor should be swept with the windows closed; then the windows should be opened and the ceiling and walls brushed with a covered broom and the dust allowed to settle. Then the floor should be wiped with a damp cloth on the broom.[1] The woodwork should be cleaned with a damp cloth and a soap that is not too strong. Soda or sapolio should not be used. The furniture should be carefully uncovered and all arranged in perfect order.

The things that are highest up should be dusted first and care should be taken to collect all dust in the dust cloth. The cloth should be shaken out of doors after collecting the dust, washed thoroughly, and boiled after using. The dust cloth should be dampened before using on all surfaces except the polished furniture and windows.

Sweeping should be done with short strokes and the broom kept close to the floor, so that the dust will not fly about. The corners of the room should be swept first, the dust gathered in the center of the room and then swept into the dust pan. The dust should be burned up; for it may contain disease germs. The broom should be cleaned after using.

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[1] If the floor is of unfinished wood it will require a thorough scrubbing. After sweeping the floor and allowing the dust to settle, a small portion should be scrubbed at a time with a floor brush and soap. The grain of the wood should be followed when scrubbing. Scrubbing water should be changed frequently. A cloth should be wrung out of clear water for rinsing and drying the floor.

Small rugs should be cleaned out of doors. They should be swept, beaten, and reswept, then rolled until ready to put on the floor. If the rug is a large one and can not be removed, it should be wiped over with a damp cloth, rolled up, and the under side of the rug and the floor beneath it wiped up.

After the room has been cleaned, the windows should be arranged so that a supply of fresh, clean air can come constantly into the room. This is essential to every room in the house if perfect health is to be maintained.

PRELIMINARY PLAN.

It will be well to have Lesson IX given in one of the homes some day after school hours, if possible. If that can not be arranged, the schoolroom can be utilized as the place for practice.

METHOD OF WORK.

Devote Lesson VIII to a discussion of the methods of cleaning and to various short tasks about the schoolroom. In Lesson IX have the girls go through the entire process of cleaning a room. Assign some portion of the task to each one of the girls so that all of them can take part in the work. Supervise the work carefully, assign home practice in the cleaning of rooms, and have each girl clean a room at home once a week for a month

LESSON X. CARE OF THE BEDROOM.

SUBJECT MATTER.

As soon as one is dressed in the morning, the windows in the bedroom should be opened to air the room and the bedclothes should be separated and put on chairs before the window to air. The slops should be emptied and the chamber washed with cold water, using a special cloth. The bowl should be washed in warm, soapy water, which should then be poured into the chamber and used for washing it. The toilet articles should be washed, then the bowl rinsed and wiped dry. The slop jar should be washed out thoroughly, and frequently the slop jar and the chamber should be washed out with chloride of lime or some other disinfectant. The pitcher should be filled with fresh water and all articles arranged neatly on the washstand. If towels are soiled, clean ones should be supplied. The bed should be made carefully, the mattress turned, the first sheet tucked under the mattress all around, and the other covers tucked in at the bottom and two sides of the bed. The bed should be kept free from wrinkles and smooth in appearance. The pillows should be well shaken and arranged at the head of the bed. The floor should be brushed up, the furniture dusted, and everything put in place. The windows should be left partly opened so that the bedroom is well aired. A sufficient amount of fresh air is absolutely essential in a bedroom, and it is important that the room be well aired out during the day and left with windows open at night.

When the room is to be thoroughly cleaned, the frame of the bed should be dusted and the bed made up. The window shades should be dusted and rolled up. Curtains should be well shaken and covered if one has a dust sheet. All small articles on the bureau, table, and shelf should be placed on the bed and the whole covered with a sheet. Tables, chairs, and any other movable pieces should be dusted and set outside the room or covered. Rugs should be rolled up and cleaned out of doors. The room should be swept and dusted. As soon as dust has settled, covers should be removed from the furniture, and the furniture, rugs, and all small articles should be restored to their places. Shades should be adjusted and the room left in perfect order. The broom and everything else that has been used in the work should be cleaned and put back into place.

PRELIMINARY PLAN.

It may be possible for the teacher to give this lesson in her own bedroom or in the bedroom of some of the neighbors. Unless this is feasible the only way to have it effective is to have the girls report each day on the work they do at home.

METHOD OF WORK.

Illustrate each process and give reasons for everything that is done. Emphasize the importance of the sanitary care of the bedroom, a regular time for doing the work, and the benefit of having each member of the family care for her own personal belongings and her own portion of the bedroom.

LESSON XI. CARE OF LAMPS.[1]

SUBJECT MATTER.

Directions for cleaning and filling the lamp.—A bright light comes from clean burners that allow a good draft. This means constant care on the part of the one that looks after the lamps. In the daily cleaning of lamps, first dust the chimney shade and the body of the lamp. Wash the chimney. If sooty, clean with newspaper before washing. Next, turn the wick high enough to show all the charred part; cut this off, making it perfectly even, then rub with a piece of soft paper. Wipe off the burner and any other part of the lamp that seems oily. Dry with another cloth. Fill the body of the lamp with oil within an inch of the top, leaving plenty of room for the gas that may be generated from the kerosene. The gas that is generated in a lamp that has been used many times without refilling may be a source of danger.

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[1] It is assumed that the teacher is acquainted with the possibilities of electricity and other methods of better lighting in country homes, and will instruct her pupils in the economic use of modern lighting facilities.

When lighting the lamp first turn the wick down, allowing the chimney to become heated gradually. If necessary to move the lighted lamp, first turn the wick low. The flaring up of the flame smokes the chimney. Do not leave a lighted lamp in a room where there is no one to watch it. When putting out the light, blow across the chimney, never down into it, as this might send the flame down into the kerosene.

About once a month give the lamp a thorough cleaning. Spread out a newspaper and take the lamp apart. Wash the chimney and shade in hot water and dry with a towel. Polish, using soft paper. Boil every part of the burner in water to which two tablespoons of soda have been added. Put new wicks in if all old ones are dirty. Put the parts all securely together again. Keep an old pan and cloths exclusively for this purpose, and be very careful not to get a drop of kerosene or the dirty hands near any foods.

Have a regular time of the day for cleaning lamps, preferably immediately after all the morning work has been done after breakfast. Do not fill the lamps near the kitchen stove. Do not light a match while the oil can is out. Never fill a lamp while lighted or while near another one which is lighted. If a fire is caused by kerosene, smother it with a heavy rug or woolen garment. Do not attempt to put it out with water.

PRELIMINARY PLAN.

It will be well to give this lesson just before some evening entertainment at the schoolhouse. If there are no lamps at the school have a few brought in from neighboring homes. Secure an old pan and cloths to use in cleaning.

METHOD OF WORK.

Talk with the girls about the cost and properties of kerosene and the danger of having a light near a can of kerosene. Explain the draft by means of which the kerosene can be made to burn on the wick, and the danger if the burner becomes clogged up and the draft cut off. Have the lamps taken apart, burners boiled, chimneys cleaned, and body of the lamps filled and wiped off. Then have the lamps lighted to see that they burn properly.

LESSON XII. PREVENTION OF PESTS.

SUBJECT MATTER.

Household pests are annoying, dangerous to health, and destructive to property. Pests carry disease germs from one person to another and from other animals to human beings. Absolute cleanliness in every part of the house is essential if the place is to be kept free from pests. As a rule, pests flourish in dark, damp, dirty places. The housekeeper can keep her place free from pests with the proper care. If pests get started, the housekeeper should know how to exterminate them.

A few simple methods of extermination are here given:

Bedbugs.—Kerosene should be poured into all cracks and a brush, dipped in kerosene, run briskly over all surfaces. Care must be taken to have no fire in the house while this is being done. Windows should be open and the room kept free from dust. In four days this should be repeated, to kill any bugs that may have just hatched.

Cockroaches and waterbugs.—A solution of 1 pound of alum to 3 pints of water should be poured into all cracks. Insect powder and borax are also effective. Absolute cleanliness and freedom from dampness are necessary if the house is to be kept free from roaches.

Ants.—Oil of cloves or pennyroyal on pieces of cotton batting scattered about in the places where ants appear will drive them away. Saturating the nests with coal oil will destroy them. Food which attracts ants should be removed from places which they are apt to reach.

Rats and mice are best exterminated by the use of a trap or some preparation like "Rough on Rats." Traps should be set nightly and should be scalded and aired after a mouse has been caught. Rat holes may be stopped up by sprinkling with chloride of lime and then filling with mortar or plaster of Paris.

Mosquitoes breed in swampy places or in old barrels or kegs or tin cans which hold stagnant water. Therefore, if the swampy places be drained and the grounds about the house kept free from stagnant water the housekeeper will generally not be troubled with mosquitoes. Empty barrels or kegs should be inverted and old tin cans should have a hole punched in the bottom so that they will not catch water. All high weeds near the house should be cut down and destroyed so that they will not provide a damp place to harbor mosquitoes. If it is impossible to get rid of all standing water, the breeding of mosquitoes can be checked by pouring kerosene oil on the water. One ounce of oil on 15 square feet of water is sufficient. This will have to be renewed at least once in 10 days. The doors, windows, and ventilators of the house should be well screened as a protection against mosquitoes.

Flies are one of the greatest carriers of typhoid and other germs and filth of all sorts. They can be gotten rid of only when the breeding places are destroyed and the flies killed as rapidly as possible. Materials that attract flies should not be exposed in and about the house. The house should be well screened with wire mesh or mosquito netting to keep out the flies. A fly swatter should be kept at hand. Stables should be cleaned daily and the barn lot frequently sprayed with kerosene, creoline, or lime.

Fleas will be troublesome if cats or dogs are kept in the house. These house pets should be given frequent baths, the rugs on which they lie should be brushed and shaken daily, and the floors washed with soap and water and wiped with kerosene.

Moths are apt to develop in woolen garments unless the garments are thoroughly shaken and absolutely protected by wrapping in newspaper and put away. Woolen garments that are used only occasionally should be kept in a light, dry place, handled frequently, and hung in the sun occasionally. Moths or carpet beetles can be exterminated from carpets by applying kerosene.

PRELIMINARY PLAN.

Give this lesson at a time when the girls are asking about the household pests or when the school is suffering from some pests. It would be well to have the lesson in the spring just before school closes, so that the girls can put into practice what they learn. It may be desirable to devote the efforts to the destruction of one particular pest. For example, a fly crusade may be inaugurated.

METHOD OF WORK.

If there are pests in the schoolroom, discuss their habits, what seems to attract them, where they come from, etc. Have girls report any pests they have at home. Explain why they are dangerous, tell how they can be exterminated, and assign to each girl the extermination of one household pest. Have her report each day the success of her efforts. Continue this work for several weeks.

LESSON XIII. REMOVING STAINS, BLEACHING FABRICS, AND SETTING COLORS.

SUBJECT MATTER.

As garments and household linens are apt to become stained and thus lose their attractiveness, it is well to know remedies for the most common stains and the principle upon which their removal depends. All stains should be removed as soon after they occur as possible. Boiling water will loosen and remove coffee, tea, and fresh fruit stains. The stain should be held over a bowl and the water poured upon it with some force. Cold water will remove stains from blood or meat juice. Soaking will help in the removal of blood stains. Rust stains can be removed by wetting the stain with lemon juice, covering with salt, and placing in the sun. Stains from stove blacking, paint, and grass can be removed by soaking in kerosene and washing well with soap and water. Ink stains can be removed by soaking in water, removing as much as possible, then soaking in milk. Stains from cream and other forms of grease can be washed out in cold water, followed with warm water and soap.

White cotton and white linen materials can be bleached by exposing while damp to the sunshine. If left out overnight the bleaching process is made effective by the moisture furnished by the dew and frost. A stream of steam from the teakettle may also help the bleaching process.

Some colors are set by the addition of a small amount of acid to the first water in which they are soaked, while others are set by the use of salt. It is necessary to try a small amount of the material before dipping in the entire garment in order to be sure of results. Vinegar should be used for blues; use one-half cup to one gallon of water. Salt is most effective for browns, blacks, and pinks. In most cases two cups of salt to one gallon of cold water will be enough.

PRELIMINARY PLAN.

The towels used for drying dishes or the linen used for some school entertainment may have become stained with coffee, fruit, or some other substance. Make this the basis of a lesson and have the girls bring other things from which they wish to remove stains. Each girl should have an article from which to remove a stain. Let this lesson be preliminary to the lesson on laundry work.

METHOD OF WORK.

Examine the various articles at hand from which stains are to be removed. Discuss the method of removal and have each girl work on her own stain until it is as nearly removed as possible.

LESSON XIV. WASHING DISH TOWELS, SCHOOL CURTAINS, ETC.

SUBJECT MATTER.

Dish towels should be thoroughly washed out at least once a day. Wash one piece at a time (cleanest first) in warm soapy water and rinse in clear water in another pan. Hang up in the sun, if possible, so that the air will pass through. Boil at least once a week in soapy water to keep fresh and white. Sunshine and fresh air are valuable for the purpose of bleaching and purifying.

Wash the school curtains in hot, soapy water; boil, rinse, and blue slightly. A small amount of thin starch may be desirable for the curtains. A thin starch can be made as follows:

RECIPE FOR THIN STARCH.

½ cup starch.	½ cup cold water.
¼ teaspoon lard.	3 pints boiling water.

Add the cold water to the starch and lard, stir until smooth, then add the boiling water slowly, stirring constantly. Boil for several minutes in order to cook the starch thoroughly; then add one pint of cold water and a small amount of bluing. Dilute if necessary.

Hang the curtains in the sun to dry, shaking well before putting on the line and folding the edge over at least 6 inches. Be sure to have a clean line. When dry, fold carefully. A short time before ironing, sprinkle well.

PRELIMINARY PLAN.

It may be desirable to give this lesson earlier in the course, if cooking lessons are being given and dish towels are in use, or if the school curtains are badly soiled. Other articles may be washed if time and facilities permit.

METHOD OF WORK.

Discuss briefly the need for laundry work and the general principles. Have the girls each take a turn washing the towels or curtains; examine the article after it is washed and give careful directions for the boiling, bluing, and starching. While these processes are being completed, have some of the girls prepare the line. Have two girls appointed to bring the towels in off the line before they go home from school.

LESSON XV. IRONING.

SUBJECT MATTER.

To do good ironing it is necessary to have a firm, unwarped ironing board. This should be covered with some thick woolen material and a white muslin cover that is clean, smooth, and tightly drawn. The thick cover should be tacked on, while the top cover should be pinned so that it can be easily taken off for cleaning. A heavy holder should be provided for handling the irons. Irons should be clean and smooth. Paper should be kept at hand to keep the irons clean and a piece of beeswax, sandpaper, or salt should be provided for keeping them smooth. A small cloth should be used to wipe off the iron after using the beeswax. A newspaper should be spread on the floor to protect any pieces that may hang down that far while being ironed. The coarser towels should be ironed first, as the irons grow smoother the longer they are used. Starched pieces should not be ironed until the irons have become very hot. Every piece should be ironed until perfectly dry. If the article is first laid smooth it will be easier to iron it and keep it in shape. As soon as ironing is completed the articles should be hung up to air out well.

PRELIMINARY PLAN.

Arrange to have the ironing lesson just as soon after the laundry lesson as possible. It will probably be easy to borrow the necessary equipment from near-by homes. Each girl can be appointed to bring something that will contribute toward the equipment and one girl can be appointed to have the fire ready and another to put the irons on to heat before the lesson hour.

METHOD OF WORK.

Call the girls together early in the morning or at some other time previous to the lesson period and give them directions for sprinkling the articles to be ironed. When the class hour comes, demonstrate the method of ironing, folding, and hanging the articles and have the girls take turns doing the work.

LESSONS XVI AND XVII. CARE OF THE BABY.

SUBJECT MATTER.

Because young girls are fond of little children and must often help their mothers with their baby brothers and sisters, they should know how to care for them. It is essential that they understand the following points: The little body needs protection. The head is soft and the brain may be injured by hard bumps or pressure. The skin is tender and is easily irritated by the bites of insects, friction, etc. Kicking, wiggling, etc., are necessary to the development of the baby's muscles, but the baby should not be played with all the time for it is well for it to lie quietly a portion of the time while awake. It should not be made to sit up until ready to do so. A desire to creep should be encouraged. Standing or walking should not be taught the baby until it tries to do so for itself and then it must be helped very carefully.

The baby should have plenty of fresh air and should be allowed to spend much of its time out of doors. In cold weather the baby must be warmly covered and sheltered from high winds. Its eyes should always be protected from strong sunlight.

Regular hours should be observed for sleep and the baby should be put to bed early at night. If the house is not well screened, a mosquito bar should be put over the baby's crib. Clothing should be light and loose, so that the body can move freely.

Perfect cleanliness is necessary to keep the baby's skin in good condition. A daily bath should be given. A morning hour is usually the best time for bathing the baby, midway between the meals. The baby should be taught to use the chamber before the bath and after the nap. Everything should be ready before the baby is undressed. The room should be very warm. The water should be only moderately warm and should be carefully tested to make sure that it is not too hot. The towels and covers for the baby should be at hand. The head and feet should be washed first, and the body soaped before putting the child into the bath. Little soap should be used for washing the baby, for even the best soap is strong and apt to irritate the delicate skin. The bath should be given quickly, the body wiped very dry and covered as soon as washing is completed.

The baby should be fed in small quantities at regular intervals and given plenty of cold water to drink. Not until 11 or 12 months of age should it be given solid or semisolid food. Even then milk should continue to form the basis of the child's diet, and of this a considerable quantity should be used—about a quart a day from the twelfth month on. As the child grows older a more varied diet will be necessary. The most hygienic methods of food preparation must always be observed.

Certain foods should never be given: Fried foods, pastries, condiments, pickles, preserves, canned meats, fish, pork, sausage, cheap candies, coarse vegetables, unripe and overripe fruits, stimulants, foods treated with a preservative or coloring matter, and half-cooked starches.

PRELIMINARY PLAN.

The teacher should talk with the girls in order to see what points in connection with the care of the baby it is necessary for them to know in order to do their work at home intelligently.

METHOD OF WORK.

It will probably not be possible to have anything more than a class discussion of the points in question, but the girls' home experiences ought to make this discussion vital. If there is a nurse is the neighborhood who can be secured to give one lesson on the care of the baby, the teacher should supplement her own lessons with an additional lesson by the nurse.

In connection with the care of the baby the teacher will be able to secure help from bulletins entitled:

Infant Care, Care of Children, Series No. 2, Bureau Publication No. 8, Children's Bureau, United States Department of Labor, Washington, D. C.

Food for Young Children, Farmers' Bulletin 717, Division of Publications, Department of Agriculture, Washington, D. C.

The Care of the Baby, United States Public Health Service.

The Summer Care of Infants. United States Public Health Service.

LESSON XVIII. COST OF FOOD, CLOTHING, AND HOUSE.

SUBJECT MATTER.

It is of great importance that all children learn the value of property in an elementary way. This will prepare them for the knowledge of the cost of living that is essential. They can learn that the cost of food can be decreased by keeping gardens and by proper choice, care, and handling of foods; that care of clothing will reduce this item of expense; and that the owning of one's own house and lot is something worth working for in order to reduce the cost of rent.

PRELIMINARY PLAN.

The teacher will have to acquaint herself thoroughly with conditions in the community so that she can talk intelligently with the girls, emphasize the right points, and give them constructive help.

METHOD OF WORK.

Begin with a discussion of the cost of food; how much the children earn or spend during the week; and why it is worth while to cook and sew well, and look after property. Continue such discussions from time to time in connection with other school work.

LESSON XIX. HOW TO KEEP ACCOUNTS.

SUBJECT MATTER.

It is well for one to keep a written record of all money received and all money spent. Children should be taught to do this as soon as they are big enough to have money in their possession. A simple little notebook in which all expenditures are entered on the right side and all receipts on the left side, with the balance drawn up each week or month will prove an easy and satisfactory method of keeping accounts. If the little girl learns to do this with her pennies, she will be better able to take care of the more important household accounts when she is in charge of a home. However, there will be no good incentive for her to keep accounts unless she is endeavoring to save for some good purpose. If she learns to save for the future purchase of a book, a dress, or some little treat, she will feel that her account keeping is worth while. As a housekeeper she will appreciate the importance of saving for some future good to the family—a better house, school for the children, etc.

PRELIMINARY PLAN.

In order to make the lesson on keeping accounts of vital interest, introduce it at a time when the girls in the class are saving for some specific purpose—material for a dress to be made in sewing class, refreshments for a party for their mothers, a school library, or something else that will be a pleasure and help in school work.

METHOD OF WORK.

After discussing the possible sources of income of the girl and of her family, and the means of increasing and taking care of that income, discuss simple methods of keeping accounts, illustrate them on the blackboard, show how to balance the accounts, and see that each girl has a small book for the purpose. It may be necessary to make or to rule this book as a portion of the class exercise.

LESSON XX. CARE OF THE EXTERIOR OF THE HOUSE.

SUBJECT MATTER.

Closely allied to the housekeeper's work within the home is the care of the exterior of the house and its surroundings. It is absolutely necessary that the grounds be kept neat and clean. In addition to this they should be made attractive by the careful selection of a few shrubs rightly placed. While the gardens at the rear of the house may be planned solely for the pleasure and use of the family, in planning the lawn at the sides and front of the house the neighbors and passers-by must be considered. The grounds should be a picture of which the home is the center, the shrubs being grouped to frame the picture. In order to do this, the center of the yard should be left open with an occasional tree or shrub, so placed and pruned that it will not hide the house. Shrubs and vines should be planted close to the house to break the severe line between the house and lawn, and so utilized as to hide the sheds. The arrangement and varieties of shrubs and vines should harmonize both at the front and sides of the house. One, two, or three kinds should be chosen as a basis. If a shrub is planted at one corner of the house, the same variety should be planted at the other end. Similarly, the same sort of vine should be planted on both sides of the front porch. Care should be taken that vines do not cut off the supply of light and air from the interior of the house.

The following list of shrubs and vines for planting close to the house may be suggestive:

Shrubs: Barberry, deutzia, forsythia, hydrangea, Japanese quince, dwarf euonymus, lilac, privet, spirea, snowball, cape jasmine, sweet shrub.

Vines: Boston ivy, clematis, English ivy, honeysuckle, wistaria, climbing roses, climbing euonymus.

The center of the lawn should be left free of unnecessary walks, drives, piles of stones, or pieces of statuary. A few flowers should be planted among the shrubs to give color at different seasons.

The exterior of the house itself must be considered, if the picture framed by the shrubs and vines is to be a pleasing one. The house should be painted in a soft brown or dark green to blend with the landscape of oaks and pines. The paint will help to preserve the house, but its color must be carefully chosen in order to give a pleasing effect.

The back yard should be used for vegetable gardens with flower borders. For this purpose a deep, rich soil is necessary and every square foot of space should be utilized. Every family should learn to make use of an increased number of vegetables and fruits and to cook them in a variety of ways. No crops should be allowed to go to waste. Intensive 12-months gardening should be practiced. A family of five people could be entirely provided with vegetables from a garden less than 75 by 50 feet.

With the exception of sweet peas, all flowers needed for picking purposes should be grown in the flower borders in the back yard. Sweet peas should be planted in rows in the vegetable section. The attractiveness, as well as the usefulness, of the flower borders depends upon the choice and arrangement of flowers. The flowers should be chosen as to height of plants, color of blooms, and seasons of blooming. The tallest plants should be placed at the back of the border; for a border 6 feet wide none of the plants need be over 5 feet. There can be a riot of colors if the flowers are arranged in clumps of four to six throughout the entire length of the border. In a well-planned flower border some flowers should be in bloom each month. Hardy perennial flowers should predominate, with enough annual flowers to fill up the spaces and hide the soil. A surprisingly large number of plants will be needed. Perennial flowers should be started in seed beds in March and the plants transplanted into the flower borders in October. Annual flowers should be started in flats in early spring and the plants transplanted into the flower borders in April. The well-tried, old-fashioned flowers will give the best satisfaction. Every four years the flower borders need to be spaded, well manured, and replanted.

LISTS OF FLOWERS FOR BORDERS.

Perennials.—Bleeding heart, carnations, chrysanthemums, columbine, coreopsis, dahlias, gaillardias, golden glow, iris, larkspur, oriental poppies, peonies, phlox, pinks, platycodon, snapdragon.

Biennials.—Forget-me-not, foxglove, Canterbury bells, hollyhock, sweet-william, wallflower.

Annuals.—African daisy, ageratum, aster, calendula, calliopsis, balsam, candytuft, cornflower, cosmos, marigold, mignonette, nasturtium, petunia, poppy, stock, sweet alyssum, sweet pea, verbena, zinnia, annual phlox, red sunflower, cut-and-come-again sunflower.

Each home gardener will need to study garden literature to help solve the garden problems, for the day has passed when one needs only to scratch the soil with a shell, plant the seeds and receive an abundant crop. To-day successful gardening depends upon intelligent management of the soil and crop, and upon persistent labor.

The Department of Agriculture at Washington, D. C., publishes many helpful farm bulletins that may be secured free of charge.

Many State experiment stations publish bulletins on vegetable growing. These bulletins are sent free of charge to the people within the State on application to the director of the experiment station. A few of the bulletins published by southern experiment stations are:

The Home Vegetable Garden.—Virginia Truck Experiment Station, Norfolk, Va.
Truck Growing in North Carolina.—Department of Agriculture, Raleigh, N. C.
Vegetable Gardening.—Georgia Experiment Station, Experiment, Ga.
Farm Gardens.—Division of Extension, College of Agriculture, University of Tennessee, Knoxville, Tenn.

Books on gardening that are useful for the home garden.

Card.—"Bush Fruits." Price, $1.50. The Macmillan Co., New York City.
Duncan.—"When Mother Lets Us Garden." Price, 75 cents. Moffat, Yard & Co., New York City.
Ely.—"A Woman's Hardy Garden." Price, $1.75. The Macmillan Co., New York City.
French.—"The Beginner's Garden Book." Price, $1. The Macmillan Co., New York City.
Lloyd.—"Productive Vegetable Garden." Price, $1.50. Lippincott Co., Philadelphia.

The United States Bureau of Education through its division of school and home gardens sends out literature and gives direct assistance to those schools that wish to have the home-garden work carried on by their pupils.

PRELIMINARY PLAN.

The teacher should visit the homes of all the children in order to make herself familiar with the condition in which their grounds are kept. She may be able to secure permission from one of the housekeepers to use her grounds for the practice place for the lesson, or it may be more desirable to give this lesson at the school and to conduct a school garden as a model home garden.

METHOD OF WORK.

Discuss the arrangement and care of the home or school grounds. Have the class clean up the lawn and garden chosen for the lesson, supervising the work carefully. Assign the cleaning up of the home lawns or work in the home gardens for the coming week. Let this lesson serve as a means of interesting the girls in home gardening, if that has not already been taken up, or of emphasizing the relation of gardening to the housekeeper's work if they are already interested in gardening.

TWENTY LESSONS IN COOKING.

For the Rural Schools.

OUTLINE OF THE COURSE.

Lesson I. Discussion of foods and cooking. Management of the kitchen stove. Cooking by dry heat. Baked vegetables or fruit.

Lesson II. Water and mineral matter in vegetables. How to prepare and serve uncooked vegetables, lettuce, cress, cabbage, etc. Cooking by moist heat. How to boil, season, and serve beet tops, turnip tops, cabbage sprouts, kale, spinach, or other vegetable greens.

Lesson III. The value of carbohydrates in the diet. Potatoes as a source of carbohydrates. The choice, cost, care, composition, food value, and cooking of sweet potatoes and white potatoes. Baked squash. Steamed squash.

Lesson IV. Fruits—their food value and use. Reasons and rules for canning. How to can and use such vegetables as beets, beans, tomatoes, and carrots, and such fruits as figs, grapes, muscadines, apples, and peaches. The drying of fruits and vegetables.

Lesson V. Fats and oils. Vegetables, continued. Preparation of white sauce to serve with vegetables. How to boil, season, and serve such vegetables as lima or butter beans, string beans, cowpeas, onions, okra, cabbage, collards, corn, beets, turnips, or carrots.

Lesson VI. Cereals—kinds, composition, care, and general rules for cooking. Oatmeal, cracked wheat, hominy grits, corn-meal mush, or rice. Fruits to serve with cereals—stewed prunes, stewed apples, or apple sauce.

Lesson VII. Classification of foods, reviewed.

Lesson VIII. The planning and serving of meals.

Lesson IX. Milk. Care, cost, and food value of milk. The value and use of sour milk—cottage cheese clabber. Rice or corn starch pudding (plain, caramel, or chocolate).

Lesson X. Soups. Cream soups. Cream of carrot, potato, or onion soup; green pea or cowpea soup. Toast, croutons, or crisp crackers to serve with soup.

Lesson XI. Eggs. Food value and general rules for cooking. Eggs cooked in shell, poached, scrambled and omelet.

Lesson XII. Simple desserts. Custards.

Lesson XIII. Batters. Corn bread and hoe cake.

Lesson XIV. Batters (continued). Methods of making batters light. Use of sour milk and soda. Egg corn pone and corn muffins. Baking-powder biscuits.

Lesson XV. Meat. Composition and food value. How to make tough cuts palatable. Pork chops with fried apples. Beef or mutton stew with vegetables and dumplings. Rabbit stew. Bacon.

Lesson XVI. Baked pork and beans or baked cowpeas. Corn dodgers.

Lesson XVII. Butter cakes. Plain yellow cake. Cocoa, coffee, tea.

Lesson XVIII. Yeast bread.

Lesson XIX. Serving simple dinners without meat. Baked omelet, macaroni and cheese.

Lesson XX. Sugar. Food value and cooking. The use of peanuts in candy. Peanut cookies, or peanut, molasses, or fudge candies, to be made for a special entertainment.

SUGGESTIONS FOR THE TEACHER.

The teacher should learn how the children in her school live in their own homes, what foods they use, what foods they raise, and how they prepare and serve their foods. The instruction given in the lessons should be based on this knowledge. Possibilities for the improvement of accepted methods should be considered. Those foods should be used in the recipes which the children can afford to use at home. They should be encouraged to raise other foods in their gardens and to keep chickens, pigs, and cows.

Elementary principles of nutrition and sanitation should be taught. Simple meals should be planned with plain but well-cooked dishes. Variations should be suggested and the value of a mixed diet emphasized. Care should be taken not to waste time on points that are unrelated to the homes of the girls, except as such points may be necessary to raise their ideals.

All the work should be carefully done. Sanitary handling of food and care in storage of foods should be insisted upon. Careful attention should be given to the dish washing, care of dish towels, etc., emphasizing those points in sanitation involved. The girls should be drilled faithfully in all points essential to the handling of anything that comes in contact with the food.

Proper methods of sweeping and cleaning should be employed and thoroughness practiced in every detail of the work. Thorough drill in these processes should be given.

The order in which the lessons are to be given will be regulated in part by the season of the year in which they occur, the locality, the foods obtainable, and any special local needs. However, care must be taken that the lessons occur in proper sequence, so that the pupils will see the relation of one to the other and will appreciate the value of each. It may be necessary to combine two lessons or to give only part of a lesson. In some of the lessons more recipes are suggested than could be prepared in a brief period. In every case the choice of recipe will have to be made by the individual teacher. Wherever possible, simple experiments to show the composition and effect of heat on food should be used.

No attempt has been made to give a complete set of recipes. Those included are chosen to illustrate the subjects to be discussed in the lessons. A few have been taken from the Farmers' Bulletins and from circulars of the Extension Service of the Department of Agriculture. The others have been carefully tested and used with satisfactory results. The teacher who desires to make use of a greater number of recipes will do well to supply herself with one of the textbooks listed. Level measurements should be used in the preparation of all the recipes and all the directions should be carefully followed.

The first few lessons are more fully outlined than the others, furnishing suggestions for methods of procedure that can also be adapted to the later lessons. The teacher should have a detailed plan for every lesson, outlining her method of work, the leading questions for the discussion, and the home assignment which she desires to make.

Foods that are in common use are suggested for the lessons outlined. There will necessarily be exceptions to their use in different localities. If foods used in the homes are harmful because of the manner in which they are prepared, the teacher should do all in her power to correct the custom, but she must be careful not to be too radical. If the lessons given are not repeated by home practice, time will be practically wasted. Simple meal service should be introduced wherever possible, and as much instruction on the furnishing and care of the kitchen should be included as time permits.

By the time the course is completed, the girl should be able to keep her kitchen in sanitary condition, and she should have a knowledge of food values and of the processes of cooking sufficient to provide simple, wholesome meals for her family.

For the teaching of food values, it will be helpful to secure the set of 15 food charts, that can be obtained for $1 from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The State Department of Education or the State university, college, or normal schools, through their extension departments, may issue material that will be of help to the rural teacher in planning her lessons.

The teachers will find it helpful to secure and study the Farmers' Bulletins listed below. Single copies of these bulletins can be obtained free by writing to the Division of Publications, Department of Agriculture, Washington, D. C.

FARMERS' BULLETINS.

No. 34. Meats: Composition and cooking.
No. 142. Principles of nutrition and nutritive value of food.
No. 203. Canned fruits, preserves, and jelly.
No. 249. Cereal breakfast foods.
No. 256. Preparation of vegetables for table.
No. 293. The use of fruit as food.
No. 359. Canning vegetables in the home.
No. 363. The use of milk as food.
No. 389. Bread and bread making.
No. 391. Economical use of meat in the home.
No. 487. Cheese and its economical uses in the diet.
No. 521. Canning tomatoes at home and in club work.
No. 535. Sugar and its value as food.
No. 559. Use of corn, kafir, and cowpeas in the home.
No. 565. Corn meal as a food and ways of using it.
No. 653. Honey and its uses in the home.
No. 712. School lunches.
No. 717. Food for young children.
No. 807. Bread and bread making in the home.
No. 808. How to select foods. No. I. What the body needs.

EQUIPMENT FOR COOKING LESSONS.

The following list of utensils would provide an adequate equipment for cooking lessons. Some of the utensils should be ordered in larger numbers, if the class is large and if funds permit. If it is possible to obtain serving dishes, they should be provided for a small number of persons and used both in class practice and for social purposes. If the school is an active social center and the dishes are to be in use frequently for many people, the number provided should not be so limited. If school lunches are served, each pupil may well provide his own dishes. Dust cloths, broom, etc., have been included, so that simple lessons in housekeeping may be given.

COOKING UTENSILS.

	Approximate cost.
Baking dish	$0.30
Bowls, mixing, 2	.60
Bread board	.25
Bread box	.25
Broom	.35
Brush, scrubbing	.10
Brush, vegetable	.10
Can opener	.10
Containers, lard pails or cans	
Corkscrew	.10
Cups, measuring, 2	.20
Cups, mixing, 2	.10
Cutters for biscuits or cookies	.10
Dishcloths, 2	.10
Dish pans, 2	.40
Dish towels, 6	.90
Double boiler	.75
Dust cloths, 6	.40
Dustpan and brush	.40
Egg beater	.10
Flour sifter	.15
Forks, 6	.60
Frying pan	.90
Glass jars, 6 Mason	.60
Grater	.10
Hand basin	.15
Jelly glasses, 6	.15
Kettle, 6-quart, with lid	.40
Knife, bread	.30
Knife, butcher	.15
Knife, paring	.20
Knives, case, 6	.60
Meat grinder	.70
Mop	.40

	Approximate cost.
Molding board	$0.35
Muffin tins, 2 sets	.20
Oil stove	1.15
Omelet pan	.25
Oven	.85
Pail, garbage (covered)	.90
Pails, water, 2-quart, 6-quart	.80
Pan, baking	.20
Pan, cake	.10
Pans, bread, 4	.40
Pans, pie, 2	.10
Pitcher, 2-quart	.30
Plates, 6	.30
Ramakin	.05
Rolling pin	.10
Salt and pepper shakers	.30
Saucepans, 3 (1-quart, 2-quart, 3-quart, with lids)	.60
Soap dish	.10
Spatula	.20
Strainer	.15
Tablespoons, 6	.30
Teakettle	.40
Teaspoons, 6	.30
Tray	.15
Wooden spoons, 2 small	.30
	19.85

Serving dishes.

Bowl.
Cream pitcher.
Cups and saucers.
Knives and forks.
Napkins.
Plates.
Sugar bowls.
Tablecloth.
Tumblers.

FOODS AND COOKERY.

A suggestive list of textbooks for use in elementary rural schools.

Austin, Bertha J.—"Domestic Science." Price, Vol. 1, 60 cents; Vol. 2, 60 cents. Lyons & Carnahan, Chicago.

Conley, Emma—"Principles of Cookery." Price, 60 cents. American Book Co., New York City.

Flagg, Etta P.—"A Handbook of Home Economics." Price, 75 cents. Little, Brown & Co., Boston.

Jones, Mary C.—"Lessons in Elementary Cookery." Price, $1. Lippincott Co., Philadelphia.

Kinne, Helen, and Cooley, Anna M.—"Food and Health." Price, 65 cents. The Macmillan Co., New York City.

Lincoln, Mary J.—"The School Kitchen Textbook." Price, 65 cents. Little, Brown & Co., Boston.

Metcalf, Martha L.—"Food and Cookery." Price, 95 cents. Industrial Education Co., Indianapolis.

Morris, Josephine—"Household Science and Arts for Elementary Schools." Price, 60 cents. American Book Co., New York City.

Pirie, Emma E.—"The Science of Home Making." Price, 90 cents. Scott, Foresman & Co., Chicago.

Williams, Mary E., and Fisher, K. R.—"Theory and practice of Cookery." Price, $1. The Macmillan Co., New York City.

DETAILED LESSON PLANS FOR THE COURSE IN COOKING.

LESSON I. DISCUSSION OF FOODS AND COOKING.

Management of the Kitchen Stove. Cooking by Dry Heat. Baked Vegetable or Fruit.

SUBJECT MATTER.

Foods.—The body uses food to build and repair its tissues, to provide heat and energy, and to regulate body processes. Foods differ from one another in their composition and in their ability to perform the work of the body. These differences have led to the classification of foods into five groups, which are spoken of as the five food stuffs or food principles.

Cooking.—While some foods can be used as they occur in nature, most foods are made more acceptable by the application of heat. Heat softens the structure of vegetables and fruits, makes tender the tissues of meat, prepares starch for digestion, develops flavor in many foods, and destroys parasites and germs that may be present in food. The five food stuffs are differently affected by heat, some require slow cooking, others require intense heat. Hence, it is necessary to study cooking that each food may be properly prepared.

The stove.—A knowledge of the construction of the stove and the methods whereby heat is obtained is necessary if one is to be a successful cook. For all stoves three things are necessary—fuel, a supply of oxygen, and a certain degree of heat, known as the kindling point, whereby the fire is started. The supply of oxygen is regulated by dampers and checks so arranged as to admit or cut off the draft of air.

The creative dampers are doors or slides that come below the fire box. When open they admit the entrance of air, increase the draft and facilitate combustion.

The oven damper is a flat plate which closes the opening into the chimney flue to decrease the drawing of the draft. When the oven damper is closed, the heat from the fire remains in the stove and passes around the oven.

Checks are slides or doors higher than the fire box, which, when open, allow the cold air to pass over the fire, retarding combustion.

A stove is also provided with means for disposing of the ashes, soot, and the gases formed. All parts of the stove are so arranged that they can be kept clean.

See Twenty Lessons in the Care of the Home. Lesson I.

PRELIMINARY PLAN.

There should be provided for this lesson some fruit or vegetable in season (from the homes of the pupils, if possible) that can be cooked by dry heat. Each child may be able to bring an apple or a potato. The teacher should be sure to have an oven that can be well heated for baking, and to have the fire well started before the lesson begins, so that the oven will be ready for use. If there is no oven, a pan of ashes and hot coals can be arranged to surround the pan of apples in such a way that they will bake.

A lesson in geography and nature study should be correlated with the cooking lesson to give the pupils opportunity to study the source of foods and the reasons for cooking foods.

One of the pupils should write the recipes for the lesson on the blackboard before the lesson hour.

RECIPES.

Baked Apples.

Wash the apples, core them, and cut through the skin with a knife so that the apple can expand in baking without breaking the skin. Place the apples in a baking dish, and fill each center with sugar. Cover the bottom of the dish with water one-fourth inch deep and bake until the apples are soft (20 to 45 minutes), basting them every 10 minutes. Place them in a serving dish and pour the juice over them. Serve hot or cold.

Baked Sweet Potatoes.

Scrub potatoes carefully and place in a baking pan. Bake in a hot oven from 45 minutes to one hour. When soft, break skin to let steam escape. Serve in an uncovered dish.

See Farmers' Bulletin 256, Preparation of vegetables for the table. Farmers' Bulletin 293, The use of fruit as food.

METHOD OF WORK.

Discuss very briefly the food that is to be cooked and the method of cooking it. Have as many apples or potatoes baked as there are members of the class or as the baking dish will hold.

Assign tasks to special members of the class.

Put the vegetable or fruit in the oven as quickly as possible to bake.

While baking is in process take up a general discussion of foods and cooking, and a special discussion of the food which is being used and the method of cooking employed in the lesson.

Give as thorough a lesson on the stove and combustion as time permits. Examine the baked article and discuss methods of serving it, time for serving, etc.

Use the finished product for the school lunch or have it served nicely in the class, letting the pupils taste it. Encourage them to bring a dish from home to take the results of their work home for the family meal if a school lunch is not served, or if they do not need a lunch. Give careful directions for washing dishes and supervise the housework carefully.

(It may be necessary to go on with some other recitation before the baking is completed, in which case one member of the class should be appointed to watch the oven.)

Questions to serve as a guide in the development of the lesson:

What food have we on hand for use to-day?
Does this food need cooking? Why?
How shall we prepare it for cooking?
How shall we prepare the oven?
How shall we care for the fire?
How long will it be necessary to cook this food?
(Time the baking carefully and discuss more thoroughly at the close of the lesson.)
How can we tell when it is done?
How shall we serve it?
For what meal shall we serve it?
Of what value is it to the body?
How shall we wash the dishes?

Home assignment.—Pupils should prepare the baked dish at home and report their work at the next lesson.

LESSON II. PREPARING AND SERVING VEGETABLES.

Water and Mineral Matter in Vegetables. How to Prepare and Serve Uncooked Vegetables, Lettuce, Cress, Cabbage, etc. Cooking by Moist Heat. How to Boil, Season, and Serve Beet Tops, Turnip Tops, Cabbage Sprouts, Kale, Spinach, Mustard, or other Vegetable Greens.

SUBJECT MATTER.

Water.—All fluids and tissues of the body contain large quantities of water, therefore water is regarded as one of the most important foodstuffs required by the body. Practically all foods contain some water. The fresh vegetables and fruits provide the body with a high per cent of water.

Water is a valuable medium for cooking. As it heats, small bubbles are formed which continually increase in number and size, but gradually disappear. Some time before the boiling point is reached an occasional large bubble will rise to the surface and disappear. The water has then reached the simmering point, 185°, a temperature frequently made use of in cooking. When many bubbles form and break, causing a commotion on the surface of the water, the boiling point, 212°, has been reached.

Mineral matter.—Mineral matter is a second foodstuff that is needed by the body, but the amount required is very small. If a variety of food is used there is generally enough mineral matter in the diet. Fruits and vegetables, especially fresh green vegetables, are comparatively rich in mineral matter. Mineral matter builds up the bones and certain tissues like hair, teeth, and nails, and regulates the body processes by keeping the blood and digestive fluids in proper condition.

Green vegetables.—The green vegetables hold an important place in the diet because they contain valuable mineral salts. They also contain a high percentage of water and considerable cellulose. With few exceptions they should be eaten raw, because the mineral salts, being soluble, are lost in the water in which they are cooked, and because the cellulose serves its purpose best in the crisp form. Cabbage is rendered much more difficult of digestion by cooking. Spinach, beet tops, etc., are more palatable cooked. The delicately flavored vegetables should be boiled in a very small amount of water, so that they need not be drained. Thus the mineral matter will be retained when the vegetables are served.

PRELIMINARY PLAN.

There should be provided for the lesson some fresh vegetables in season (from the home of the pupils, if possible), one that can be cooked by boiling, and one that can be served uncooked with a simple dressing.

One of the pupils should write the recipes on the blackboard before the lesson hour.

RECIPES.

Preparation of Fresh Green Vegetables.[1]

Wash vegetables thoroughly, leaving in cold water to crisp, if wilted. Keep cool until ready to serve, then arrange neatly and dress with salt, vinegar, and oil as desired, or prepare a French dressing as follows:

French Dressing.

½ teaspoon salt.
¼ teaspoon pepper.
1 tablespoon vinegar.
3 tablespoons salad oil.

Stir briskly until thoroughly combined and use at once.

Recipe for boiling and seasoning fresh, green vegetables.

Wash vegetables carefully, put on to cook in boiling water. Delicately flavored vegetables (spinach, celery, fresh peas, etc.) will require but little water and that should be allowed to boil away at the last. If spinach is stirred constantly, no water need be added. Starchy vegetables should be completely covered with water, and strong-flavored vegetables (as turnips, onions, cabbage, and cauliflower) should be cooked in a large amount of boiling water.

After vegetables have cooked for a few minutes salt should be added, one teaspoonful to each quart of water.

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[1] It may be well to omit from this lesson the uncooked vegetable that is served in the form of a salad and to give it at some other time. It is not well to attempt to teach more than the girls can master thoroughly.

Cook the vegetable until it can be easily pierced with a fork. Let the water boil away at the last. If necessary to drain, do so as soon as the vegetable is tender. Season with salt, pepper, and butter (½ teaspoon salt, ⅛ teaspoon pepper, and ½ tablespoon butter to each cup of vegetable).

See Farmers' Bulletin 256, The preparation of vegetables for the table.

METHOD OF WORK.

Discuss the boiling of water and its value in cooking. Have the girls observe and describe the boiling of water.

If a new tin saucepan or other bright tin vessel is at hand to heat the water in, the changes which take place as the temperature increases will be more readily apparent and the girls will enjoy watching the process.

Discuss why one vegetable is to be cooked and the other served uncooked.

Emphasize the cleaning of the vegetable, its structure, composition, and the effect of the boiling water upon it.

After the vegetable has been put on to cook, discuss the method of seasoning or dressing the vegetable which is to be served uncooked, and have it prepared to serve attractively on the plates. Especial emphasis should be placed on the use of fresh, green vegetables.

Continue the discussion of vegetables, having the members of the class suggest others that can be prepared as a salad or cooked in the manner illustrated, writing the list on the blackboard for them to copy in their books.

When the cooked vegetable is tender have it drained, seasoned. and served, and serve the uncooked vegetable at the same time.

When ready for serving, have the pupils arrange their plates and forks carefully, then have them all sit down but the two who pass the two vegetables. Be sure that the pupils eat carefully and nicely. Emphasize housework as on previous day.

Questions to serve as a guide in the development of the lesson:

How shall we prepare our vegetables for serving?
Of what value is hot water in cooking food?
How must the vegetable be prepared for boiling?
Does this vegetable contain any water?
Will it be necessary to add any more?
Will it be necessary to cover the saucepan?
How hot must the water be kept? How can one tell when the water is sufficiently hot?
How can we determine when the food has cooked long enough?
How shall we serve this vegetable?
How does boiling compare with baking?
    In time? In flavor? In amount of fuel used? In amount of work necessary?

Home assignment.—Practice in the boiling and serving of vegetables.

LESSON III. THE VALUE OF CARBOHYDRATES IN THE DIET.

Potatoes as a Source of Carbohydrates. The Choice, Cost, Care, Composition, Food Value, and Cooking of Sweet Potatoes and White Potatoes, Baked Squash, Steamed Squash.

SUBJECT MATTER.

Carbohydrates.—A third class of food stuffs required by the body is known as the carbohydrates or sugars and starches. This class of foods is used as fuel for the production of heat and energy in the body. Excess of carbohydrates may be stored in the body as fatty tissue.

Potatoes.—Potatoes are a cheap source of carbohydrates. They are also valuable for their mineral matter and for the large quantity of water which they contain. Three-fourths of the potato is water. The framework of the potato has a basis of cellulose, which is an indigestible carbohydrate material. Potatoes have only a small amount of cellulose, however, and they are comparatively easy of digestion. When dry and mealy they are most easy of digestion. Sweet potatoes contain a larger per cent of sugar than white potatoes and the cellulose in sweet potatoes softens more quickly when cooking. When used for a meal, potatoes should be supplemented by some muscle-building food, such as milk, cheese, eggs, fish, or meat.

PRELIMINARY PLAN.

At some previous period the teacher should have discussed with the girls the use of potatoes and learn from them the various ways in which they cook them in their homes. She should determine upon some recipes for the lesson that will increase the variety of ways in which potatoes can be served and will improve the methods used.

Each girl should be asked to bring one or two potatoes for the lesson. It will be well to cook in class the kind of potato that is cheapest and most commonly used in the community. The best methods of cooking and means of securing variety should be emphasized.

RECIPES.

Mashed Potatoes.

6 potatoes.
¼ cup hot milk or cream.
1 tablespoon butter.
1 teaspoon salt.

Wash and pare potatoes, boil, drain, dry, and mash (with a potato masher) in the saucepan in which they were cooked. Beat them until very light and creamy; add hot milk, butter, and salt and beat again, reheat, and serve. Serves 6 to 8.

Browned Potatoes.

Wash, scrub, and pare potatoes of uniform size. Parboil 10 minutes, then put in dripping pan with meat or on a rack in a baking pan.

Baste with fat every 10 minutes when meat is basted.

Allow about 40 minutes for the potatoes.

Experiment to show presence of starch in potatoes.

Scrub and pare a potato. Examine a thin cross section.
Grate the potato. Remove the coarse shredded portion. Examine.
Examine the liquid and note any sediment.
Heat the liquid and stir until boiling. How has it changed?
Examine portion of grater. How has the color changed? Why?

Fried Sweet Potatoes.

Cut cold boiled potatoes in one-fourth inch slices, season with salt and pepper, put into a hot, well-greased frying pan, brown on one side, turn and brown on the other side.

Glazed Sweet Potatoes.

6 sweet potatoes.	4 tablespoons boiling water.
½ cup sugar.	1 tablespoon butter or other fat.

Scrub, pare, and boil potatoes 10 minutes in salted water; drain, cut in halves lengthwise and put into a buttered baking pan. Make a sirup of sugar and water, boil 3 minutes, add butter. Baste potatoes with sirup, put into a hot oven, cook 15 minutes, or until browned, basting every 5 minutes. Serves 8 to 10.

Steamed Squash.

Prepare squash as for baking, put in steamer over boiling water, and cook 30 minutes or until soft. Then scrape squash from shell, mash, and season with butter, salt, and pepper.

Baked Squash.

Wipe shell of squash, cut it into pieces for serving, remove seeds and stringy portion, place in a dripping pan, and bake in a slow oven three-quarters of an hour (until tender). Serve at once.

See Farmers' Bulletin 256, The preparation of vegetables for table.

METHOD OF WORK.

Discuss the composition and structure of the potato. Read over and discuss the recipes that are to be used.

Make assignments for work. After the potatoes have been put on to cook, have the class examine a raw potato, following the directions given.[1]

If one of the recipes requires the use of the oven, be careful to have the potatoes for it prepared first and as quickly as possible. It may be necessary to proceed with another class, assigning one pupil to take care of the baking. Special attention should be given to careful serving of the potatoes.

Home assignment.—Before the next lesson each pupil should be able to report that she has cooked potatoes at home, using the recipes learned in class.

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[1] Squash is another vegetable containing a high percentage of carbohydrate. The recipe for squash can be prepared at this time or made use of in some other lesson.

LESSON IV. FRUITS AND VEGETABLES.

Food Value and Use of Fruits. Reasons and Rules for Canning. How to Can and Use such Vegetables as Beets, Beans, Tomatoes, and Carrots, and such Fruits as Figs, Grapes, Muscadines, Apples, and Peaches. The Drying of Fruits and Vegetables.

SUBJECT MATTER.

Fruits impart palatability and flavor to other foods and exercise a favorable influence upon the digestive organs, though their food value is low. They contain a high percentage of water and only a small percentage of nutrients. Most fruits are eaten raw. Raw fruits are exceedingly valuable to the body because of the fresh acids they contain. Cooking softens the cellulose of the fruit and, therefore, renders some fruits more easy of digestion. The cooking of fruit is of value chiefly for the purpose of preservation.

The drying of fruits.—Fruits are dried so that they may be preserved for use. Bacteria and molds, which cause the decay of fruits, need moisture for development and growth. If the moisture in fruits is evaporated, the fruits will keep indefinitely. Dried fruits and vegetables can be easily and inexpensively prepared, therefore the practice of drying is feasible if one is so situated that the fruit or vegetable can be exposed to the hot sun in a clean, dry place. When dried fruits are to be used, they must be washed thoroughly and soaked for several hours, or overnight, in water, so as to restore as much water as possible. They should be cooked until soft in the same water in which they are soaked.

Canning and preserving.—Simple methods of preservation are desirable in order that vegetables and fruits be made of value for a longer period of time than through their ripening season. Canning is one of the methods most commonly employed in the home, for it is easily done, and canned fruits will keep indefinitely. Fruit which is to be canned is first sterilized by boiling or steaming, in order to destroy all germs and spores. This can be adequately accomplished by boiling 20 minutes, but a shorter time is sometimes sufficient All germs must also be destroyed on the cans and on everything which comes in contact with the food in order to insure complete success. This will likewise require 20 minutes boiling or steaming. Jars, tops, dipper, and funnel should all be placed in cold water, heated until water comes to the boiling point, and left in the water until just before sealing. It will be sufficient to dip the rubbers into the boiling water. After the fruit has been put into the can, it must be sealed so that it is perfectly air-tight. In order to do this, it is necessary to have good tops, with new, pliable rubbers, and to fit them tightly.

When the jar is to be filled, it should be placed on a board or wooden table, or on a cloth wrung out of hot water, and filled to overflowing.

Sugar is not essential to sterilization and is used only to improve the flavor. Both fruits and vegetables can be canned without sugar. However, fruits canned with a large amount of sugar do not spoil readily, for germs develop slowly in a thick sirup.

Methods of canning.—The simplest method of canning is the open-kettle method employed for small, watery fruits, such as berries, grapes, tomatoes, etc. The fruit is boiled in an open kettle (which permits of the evaporation of some of the water in the fruit) and transferred at once to a sterilized jar which is immediately sealed. The open-kettle method of canning is not satisfactory for those vegetables containing only a small amount of acid, nor is it satisfactory for all fruits. A safer method and one that secures more complete sterilization without serious change of flavor in the fruit is that known as the cold-pack method. After being transferred to the cans the vegetable or fruit is subjected to an additional period of heating of considerable length, or to three periods of briefer length on three successive days. If the three periods of sterilization are used, the process is known as the intermittent method.

The single process method is described in the recipe for canned beets. The intermittent process proves more satisfactory for canned beans.

PRELIMINARY PLAN.

The teacher should ascertain what fruits and vegetables are most abundant and select those that the class can provide for canning.

Each girl should be asked to bring some vegetable or fruit, some granulated sugar, and a jar in which to can her fruit. If the school does not possess enough kettles or saucepans in which to do the cooking, kettles or saucepans may be borrowed from the homes.

Only one fruit or one vegetable should be taken up at a time, for the preparation necessarily varies slightly and the different methods will prove confusing. It is not necessary to confine the choice of fruits and vegetables to those mentioned in the recipes included. The teacher will find it necessary to base her instruction on the products of the particular time and place of the lesson. The principles of canning should be taken up at some other period, if possible, that the cooking lesson may be devoted entirely to practical work.

RECIPES.

Canned Tomatoes.

(Open-kettle method.)

Scald and peel the tomatoes. Boil 20 minutes. Sterilize the jars, covers, and rubbers. Stand jars on a cloth in a pan of hot water. Fill jars with hot tomatoes, being careful to fill to overflowing, and to expel all air bubbles from the jar. Adjust rubber and cover. Seal. Allow to cool. Test, label, and set away in cool, dry, dark place.

Canned Grapes.

(Open-kettle method.)

6 quarts of grapes. 1 quart of sugar. 1 gill of water.

Squeeze the pulp of the grapes out of the skins. Cook the pulp 5 minutes and then rub through a sieve that is fine enough to hold back the seeds. Put the water, skins, and pulp into the preserving kettle and heat slowly to the boiling point. Skim the fruit and then add the sugar. Boil 15 minutes. Put into jars as directed.

Sweet grapec may be canned with less sugar; very sour grapes may require more sugar.

Canned Peaches.

(Intermittent process.)

Use firm, solid fruit. Peel and cut in half. If cling-stone peaches are used, they may be canned whole. Fill each jar as the peaches are peeled and add water so that they will not discolor. When the jar is entirely filled, put on the rubber and the lid, but do no fasten the lid down. Then place the jar on a rack or folded cloth in a large kettle that can be closely covered. Put in enough water to reach up several inches on the jars, cover the kettle, and bring the water to the boiling point. When hot, lift the lids and add sugar, if it is to be used, from one-fourth cup to one cup of sugar for each quart of fruit. When the boiling point is again reached, boil for 10 minutes. Fasten down the lids and boil for 10 minutes longer. Set in a place free from drafts. On two successive days return the jars to the kettle and boil for 20 minutes. Do not loosen the lids after the jars have been sealed.

Canned Beets.

(Single process.)

Boil the beets until they are three-fourths done and the skins come off easily. Remove the skins and pack the beets in a jar carefully. Cover with boiling water, to which one tablespoon of salt is added for each quart, put the top on the jar, but do not fasten it down. Place the jar on a rack or a folded cloth in a large kettle that can be closely covcred. Pour enough water into the kettle to reach within 2 inches of the top of the jar, cover the kettle, bring to the boiling point, and boil 15 minutes, then fasten the lid on securely and boil for one and one-half hours or two hours. Put aside to cool in a place that is free from drafts. As the water around the jar boils down replenish with boiling water, never with cold.

Canned String Beans.

(Intermittent process.)

Wash and string fresh, tender beans. Put into a sack or wire basket and dip into boiling water for 10 minutes. Drain, cool slightly, and pack in jars, within 1 inch of the top. Add one-fourth teaspoonful of salt to each pint jar and fill with cold water. Put on the rubbers and lids, but do not fasten the lids down. Then place the jars on a rack or folded cloth in a large kettle that can be closely covered. Pour enough water into the kettle to reach up within 2 inches of the top of the jars, cover the kettle, bring to the boiling point, and boil for 15 minutes. Then fasten on the lids and boil for 45 minutes. As the water around the jars boils down replenish it with boiling water, never with cold water. Put to cool in a place that is free from drafts. On two successive days return the jars to the kettle without opening the lids and boil for one hour.

Farmers' Bulletins: No. 203, Canned fruits, preserves, and jellies; No. 256, Preparation of vegetables for the table; No. 359, Canning vegetables in the home; No. 521, Canning tomatoes at home in club work; United States Department of Agriculture Bulletin 123, Professional Paper. Extension course in vegetable foods. Supt. of Documents, Government Printing Office, Washington, D. C. Price 10 cents.

Dried Corn.

Pick the corn early in the morning. Immediately husk, silk, and cut the corn from the cob. Spread in a very thin layer on a board, cover with mosquito netting which is kept sufficiently elevated so that it will not come in contact with the corn, place in the hot sun and leave all day. Before the dew begins to fall take into the house and place in an oven that is slightly warm. Leave in the oven over night and place out in the sun again the next day. Repeat this process until absolutely dry.

String Beans.

String beans are hung up to dry and kept for winter use.

METHOD OF WORK.

If possible, let each girl can a jar of vegetables or fruit for her own home. If the class is large, let girls work in groups of two or three.

Begin the lesson with a very brief discussion of how to prepare fruit for canning.

Let the girls proceed with the practical work as quickly as possible. Demonstrate the method of filling and sealing the jars.

Assign the care of the jars and the intermittent canning on succeeding days to members of the class and hold them responsible for the completion of the work.

The drying of some vegetables can be undertaken at school and carefully followed from day to day. It will give the girls an interesting problem.

LESSON V. FATS AND OILS. VEGETABLES—(continued).

Preparation of White Sauce to Serve with Vegetables. How to Boil, Season, and Serve such Vegetables as Lima or Butter Beans, String Beans, Cowpeas, Onions, Okra, Cabbage, Collards, Corn, Beets, Turnips, or Carrots.

SUBJECT MATTER.

Fats and oils.—Butter and cottonseed oil belong to the class of foodstuffs known as fats and oils. They increase the fuel value of those dishes to which they are added.

Fats supply heat and energy to the body in concentrated form. For this reason they should be used in limited quantity. Fats undergo several changes during the process of digestion, and the excessive use of fat interferes with the digestion of other foods and throws a large amount of work upon the digestive organs. Cooked fats are more difficult for the digestive organs to use than uncooked fats. Other foods cooked with the hot fat are rendered difficult of digestion.

Vegetables.—Vegetables should be used when in season, as they are always cheapest and at their best then. They keep best if in a cold, dry, and dark place.

It is necessary to cook most vegetables, because they contain cellulose and raw starch, which are indigestible. In old or exceedingly large vegetables the cellulose may be very tough; hence long cooking is necessary. They should be cooked only until they are tender. Longer cooking may destroy the flavor, render the vegetable difficult of digestion, and cause the color to change. In very young vegetables the cellulose is delicate, and if young vegetables do not contain much starch they may be eaten raw.

When cooked vegetables are served they are usually seasoned and dressed with butter or oil (for one cup vegetables use ½ teaspoon salt, ⅛ teaspoon pepper, and ½ tablespoon fat or oil), or a sauce is prepared to serve them.

PRELIMINARY PLAN.

It may be well to have a preliminary lesson devoted to the simple experiments with flour, liquid, and fat, in order to determine the best method of combining white sauce. However, if the lesson period is of sufficient length a few of these experiments can be performed in connection with the lesson.

There should be provided for the lesson some vegetable that is improved by serving with white sauce, and sufficient milk, butter, or other fat, flour, and salt for the sauce and the experiments. Discuss with the children the fat that is used in their homes in order to know what is available.

The recipes should be written on the blackboard before the lesson hour.

RECIPES.

Cowpeas.

Cowpeas should be cooked soon after gathering, in order to preserve their fine flavor. Cook the green cowpeas (in pod or shelled) in boiling salted water until tender. Season and serve. Dried cowpeas should be soaked over night (seven or eight hours), then boiled till tender. After absorbing water the dried cowpeas will have increased in size until each cup makes nearly two and one-half cups of cooked peas.

Okra.

The young pods of okra should be boiled in salted water until tender (about 20 minutes), drained, and seasoned with butter, salt, and pepper. Cream can be added if desired.

Collards.

After washing collards thoroughly, add to a large amount of rapidly boiling water, and boil for 15 or 20 minutes or until perfectly tender. Season with salt, pepper, and butter or serve with white sauce.

Stewed Onions.

1 quart onions.
2 tablespoons butter.
¾ cup milk.
¼ teaspoon salt.
White pepper.

Peel onions under cold water. Cook until tender in boiling water (45 to 60 minutes), changing the water at the end ot 5 minutes and again in 10 minutes. Do not cover the kettle while the onions are boiling. Drain, and serve with one cup white sauce, or add milk, butter, and pepper, cook 15 minutes, and just before serving add salt. Serves six.

Cabbage.

Cut cabbage into quarters and soak one-half hour in cold salt water to draw out insects. Chop and cook till tender in a large amount of boiling water 20 minutes. Add salt. Leave kettle uncovered. Drain and serve with butter, salt, and pepper or with a sauce. Longer cooking renders the cabbage dark in color and difficult of digestion.

Carrots.

Scrape the carrots and cut them into large dice or slices. Add to boiling salted water and boil until tender (from 30 to 45 minutes). Drain and season with butter, salt, and pepper, or serve with white sauce.

String Beans.

String the beans if necessary and cut them into 2-inch lengths. Add to boiling water. Boil rapidly with the cover partially off of the saucepan for from one to three hours, but be careful not to overcook. Turn into a colander and let cold water run upon them. Reheat with seasonings of salt, pepper, and butter or white sauce.

Salt pork may be boiled with the beans to give them added flavor.

See Farmers' Bulletin No. 256, "The preparation of vegetables for the table."

Experiments to show nature of starch.

1. Mix ½ cup cold water quickly with 1 tablespoon flour. Let stand.
2. Mix ½ cup cold water very slowly with 1 tablespoon flour. Let stand. Compare with No. 1.
3. Mix ½ cup cold water very slowly with 1 tablespoon sugar. Let stand. Compare with No. 2.
4. Mix ½ cup cold water very slowly with 1 tablespoon flour, heat, stirring constantly. Observe result.
5. Heat ½ cup water; when boiling add 1 tablespoon flour all at once. Stir.
6. Heat ½ cup water; when boiling add 1 tablespoon flour which has been rubbed smooth by slowly adding 2 tablespoons cold water to it. Compare with No. 4.
7. Heat ½ cup water; when boiling add 1 tablespoon flour which has been rubbed smooth with 1 tablespoon creamed butter.
8. Heat 1 tablespoon butter, add 1 tablespoon flour, then add slowly ½ cup boiling water, stirring constantly.
9. Heat ½ cup water; when boiling add slowly to 1 tablespoon flour which has been thoroughly mixed with ¼ cup sugar. Stir till thickened.
10. Heat 1 tablespoon dry flour in frying pan. Taste. Slowly add ½ cup cold water, then heat, stirring to keep smooth. Taste. Compare with No. 4.

White Sauce.

2 tablespoons butter or other fat.
2 tablespoons flour.
1 cup milk (heated).
1 teaspoon salt.
⅛ teaspoon pepper.

Sufficient for 1 pint vegetables.

First method.—Heat the butter. When it bubbles add flour and seasoning, mix well, add hot milk gradually, stir constantly, and allow the mixture to thicken and bubble each time before adding another portion of milk.

After the milk has been added, cook 10 minutes, stirring frequently. Serve hot over hot vegetables.

Second method.—Scald the milk, cream the cold butter by stirring with a spoon until soft. Add the flour to the softened butter and stir until smooth; then add hot milk; cook over water for ½ hour, stirring occasionally; add seasoning and serve.

Third method.—Scald one-half the milk; add remaining cold milk slowly to flour; stir this mixture into hot milk and cook ½ hour over water, stirring occasionally; then add seasoning and butter and stir until butter is melted. Serve.

METHOD OF WORK.

Review facts on boiling vegetables learned in previous lesson. Have pupils put water on to boil and prepare vegetable for cooking. If experiments are to be made, they can be performed while vegetables are cooking. If they have been prepared previously, they can be reviewed in discussion at this time. Prepare white sauce by demonstration, using the method which seems most practical. Have vegetables drained, dried, and added to white sauce. When well-heated, serve.

Questions.

What facts regarding the boiling of vegetables did we learn in the last lesson?

Does the vegetable that we are to cook to-day differ in any marked way from those we cooked before? Can we follow the same rule in cooking it?

Can we add the flour directly to the cold milk? To hot milk?

How shall we combine the white sauce?

With what other vegetables can white sauce be used?

Home assignment.—Each pupil should prepare some vegetable and serve it with white sauce before the next lesson.

LESSON VI. CEREALS.

Kinds, Composition, Care, and General Rules for Cooking Cereals. Oatmeal, Cracked Wheat, Hominy Grits, Corn-meal Mush, Rice. Fruits to Serve with Cereals—Stewed Prunes, Stewed Apples, or Apple Sauce.

SUBJECT MATTER.

The term "cereals" is applied to the cultivated grasses—rice, wheat, corn, rye, oats, and buckwheat. They are widely grown throughout the temperate zone and are prepared in varied forms for use as food. Cereals contain a high per cent of starch and a low per cent of water, with varying proportions of mineral matter and fat. In addition to these four foodstuffs already studied, cereals contain a small amount of another foodstuff known as protein, a muscle-building material. For the most part the cereals contain a large amount of cellulose, which is broken up during the process of preparation for market and requires long cooking before ready for use by the body. The digestibility of the cereals depends upon the amount of cellulose which they contain and the thoroughness of cooking. Cereals are palatable and they are valuable because they can be blended in various ways with other substances in cooking. They are beneficial to the body because they act mechanically on the digestive organs to stimulate them. The cereal is made more attactive by serving a fresh or cooked fruit as an accompaniment.

PRELIMINARY PLAN.

The cereals should be discussed in a nature study or geography lesson, and two or three kinds that are commonly used should be brought from the homes by the girls. If cereals are not commonly used as breakfast foods, the lesson can be a means of introducing them. Some girls should bring a little milk and sugar to serve with the cooked cereal. Apples or prunes should be brought to cook and serve with the cereal.

RECIPES.

Oatmeal.

3 cups boiling water.	1 cup oatmeal.
1 teaspoon salt.	

Add oatmeal slowly to boiling salted water.

Boil 10 minutes, stirring constantly, then cook slowly, preferably over water, at least one and one-half hours longer; the flavor is developed by longer cooking. Serves six.

Cracked Wheat.

Follow recipe for oatmeal, using 1 cup cracked wheat.

Hominy Grits.

Follow recipe for oatmeal, using 1 cup hominy grits.

Corn-meal Mush.

4 cups boiling water.	1 cup corn meal.
1 teaspoon salt.	

Add corn meal slowly to boiling salted water.

Boil 10 minutes, stirring constantly, then cook slowly three hours longer, preferably over water. Serves 6 to 8.

Boiled Rice.

3 quarts boiling water.	1 cup rice.
2 teaspoons salt.	

Pick rice over carefully and wash thoroughly. Add it so gradually to the boiling salted water that the water will not stop boiling. Partly cover and cook 20 minutes, or until the grains are soft; turn into a colander and pour cold water through it, drain, dry, and reheat in hot oven with door open. Serve hot as a vegetable or as a simple dessert with cream and sugar. Serves 6 to 8.

Stewed Prunes.

½ pound prunes.	1 quart cold water.

Wash the prunes in two or three waters, then soak them in cold water for several hours. Heat them in the water in which they are soaked, and cook slowly until tender, an hour or more. Serves 6 to 8.

Stewed Apples.

10 apples.	½ cup sugar.
¾ cup water.	

Cook sugar and water together until it boils.

Wash, pare, and cut apples into quarters; core, and slice quarters lengthwise into ¼-inch slices; put apple slices into boiling sirup and cook slowly until tender. Remove from sirup at once and let sirup boil down to thicken.

Apple Sauce.

10 apples.	½ cup sugar.
¾ cup water.	

Wipe, quarter, core, and pare sour apples; add the water and cook until apples begin to soften; add the sugar and flavoring, cook until apples are very soft, then press through a strainer and beat well. Serves 8 to 10.

See Farmers' Bulletins: No. 249, Cereal Breakfast Foods; No. 565, Corn Meal as a Food and Ways of Using It. United States Department of Agriculture, Bulletin 123. Professional Paper, Extension course in Vegetable Foods. Supt. of Documents, Government Printing Office, Washington, D. C.

METHOD OF WORK.

As soon as the class meets discuss the recipes briefly and put the cereals on to cook at once. Prepare the fruit. While the long cooking of the cereal is in progress discuss the composition, food value, and methods of using cereals. Then go on with another lesson and call the class together for serving later in the day. Serve the fruit and cereals together.

LESSON VII. CLASSIFICATION OF FOODS (Reviewed).

SUBJECT MATTER.

Those foods which build up and repair the tissues of the body are called protein foods, muscle builders, or flesh formers. Meat, fish, poultry, eggs, cheese, milk, cereals, legumes, and nuts are classed as protein foods.

Those foods which serve solely as fuel for the body—providing heat and energy—are classed under two groups: The carbohydrates (sugar and starches), which the body is able to use in relatively large quantities; and the fats and oils, which the body can not use in such large quantities, but which yield a large amount of heat and energy. Protein also serves as fuel, though tissue building is regarded as its special function. Sugars and starches are abundant in fruits and vegetables. Fats and oils are found in meats, fish, milk, and in some vegetable foods. Heat-giving food may be stored in the body as fatty tissue.

Mineral compounds must be present in our food to help in the regulation of the body processes and to enter into the composition of the structure and the fluids of the body. Mineral compounds are best supplied by the fresh green vegetables, fruits, and milk.

Water is absolutely essential to the body and is present in large quantity in many foods, and is combined with many other foods during the processes of cooking.

One or more of the foodstuffs sometimes predominate in a single food. For example, rice is almost entirely carbohydrate; butter almost pure fat. Occasionally we find a food that contains all the five groups of food principles. Milk is an example of such a food and milk contains all five food principles in such proportion as to supply all the nourishment which the baby needs during the early months of its life. As the baby grows older, foods rich in carbohydrates must be added to the diet in order to supply a sufficient amount of energy for activity. Wheat contains all that the body needs for nourishment except for the absence of water. This lack is usually remedied by the addition of water when cooking.

Protein foods.

- Meats.
- Fish.
- Poultry.
- Eggs.
- Cheese.
- Milk.
- Cereals.
  - Wheat.
  - Oatmeal.
  - Rye.
- Legumes.
  - Peas.
  - Beans.
  - Lentils.
  - Peanuts.
- Nuts.

Fat foods.

- Cream.
- Butter.
- Lard.
- Fat meats.
- Fish.
- Salad oil.
- Nuts.
- Chocolate.

Carbohydrate foods.

- Sugar.
- Honey.
- Syrup.
- Winter vegetables.
  - Potatoes.
  - Parsnips, etc.
- Cereal preparations.
  - Meals.
  - Flours, etc.
- Fruits.
- Prepared foods.
  - Bread.
  - Crackers.
  - Macaroni.
  - Jellies.
  - Dried fruits.
  - Candy.

Foods rich in mineral matter.

- Fruits.
- Vegetables.
  - Spinach.
  - Tomatoes.
  - Onions.
  - Turnip tops.
  - Cauliflower.
- Cereals.
  - Grits and other coarse preparations.

Choice of food.—Our diet must be carefully chosen to give a needed variety and to properly combine the foods so that we may have the right amount of all the foodstuffs. Each meal should contain some protein food, some fats or carbohydrates, some mineral matter, and water. All five forms of foodstuffs must occur in the day's diet. The greater part of the water which the body needs should be taken between meals.

See Farmers' Bulletins: No. 142, Principles of nutrition and nutritive value of food; No. 712, School lunches; No. 808, How to select foods. No. I, What the body needs.

METHOD OF WORK.

Review the foods discussed in the previous lessons and sum up the classification of foods, being sure that the pupils can name common examples of each. Discuss simple combinations for the different meals, using dishes already prepared in the course and creating an interest in other recipes to be prepared in the succeeding lessons.

LESSON VIII. THE PLANNING AND SERVING OF MEALS.

SUBJECT MATTER.

Experience has shown that some foods are more acceptable at one time of day than other foods, and that foods are more pleasing in certain combinations than in others. The choice of food will also depend upon the season of the year. For example, a breakfast is made up of simple foods that are not highly seasoned nor subjected to elaborate methods of cooking. A fruit, a cereal, and bread, with possibly eggs or meat, are served at breakfast. A beverage, usually hot, is added to breakfast by most people.

Fundamentally, dinner consists of a hot meat or other protein dish with one or two vegetables. Soup, salad, and a sweet dessert are often served with the dinner. The soup is served before the meat course and the salad and dessert follow the meat course. The dessert may be a fruit, a cooky, or other pastry, a pudding or a frozen dish.

Lunch or supper may be a very simple meal, consisting of a soup with crackers, one protein dish (eggs, milk, or meat) with bread and stewed fruit, or a salad with a simple dessert.

EXAMPLES OF WELL-CHOSEN MENUS.

Breakfast.

No. I. Apple sauce. Hominy or oatmeal.
Sausage or bacon. Milk toast.
No. II. Baked apples. Cracked wheat.
Eggs in the shell. Corn muffins.
No. III. Stewed figs or berries. Cornmeal mush.
Poached eggs.[1] Toast.

Dinner.

No. I. Pork chops. Fried apples. Mashed turnips.
Baked sweet potatoes. Bread.
Rice pudding.
No. II. Beef or mutton stew. Spinach or turnip tops.
Biscuits. Cornstarch pudding.
No. III. Baked beans or cowpeas. Creamed cabbage or collards.
Fried sweet potatoes. Corn dodgers.
Grape sauce.

Supper.

No. I. Egg corn pone. Buttermilk or sweet milk.
Stewed apricots or other fruit. Peanut cookies.
No. II. Omelet. Creamed potatoes. Corn bread.
Fresh fruit.
No. III. Cream of carrot soup. Cottage cheese.
Biscuits. Sirup.

See Farmers' Bulletins: No. 717, Food for young children; No. 808, How to select foods; No. I, What the body needs.

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[1] Eggs should be omitted from the breakfast menu if they are not easily obtainable.

The table should always be neatly set with individual places arranged for each one who is to partake of the meal. Each place should be wide enough for a plate with a knife and spoon at the right and a fork at the left. A tumbler should be placed at the point of the knife and a napkin at the left of the fork. Everything placed on the table should be perfectly clean, the napkin should be neatly folded, and all the articles should be uniformly arranged to give a neat appearance to the table. A flower or plant in the center of the table will add to its attractiveness. Salt, pepper, sugar, vinegar, and anything of the sort that may be needed with the meal should be arranged near the center of the table where it can be easily reached. Fresh water should be poured into the tumblers just before the meal is served. The bread, butter, etc., can be placed on the table several minutes before the meal is announced, but the hot dishes should be placed immediately before the family is seated.

PRELIMINARY PLAN.

If Lesson VI, entitled "Setting and Clearing the Table" (as outlined in the course on the care of the home), has been given, this lesson can be devoted to what to serve and how to serve it, or this lesson can precede the lesson on table service. The manner of serving can be demonstrated in the next lesson in connection with the course in the care of the home.

Simple equipment for family service will be required if the form of serving is to be taken up. For class practice a table for four can be arranged. This will necessitate a table cover, five or more dinner plates, four butter dishes or plates, four tumblers, four cups and saucers, four knives, four forks, four teaspoons, four napkins, a platter, one serving spoon, and one serving fork.

METHOD OF WORK.

Discuss meal service both from the standpoint of choice and combination of foods and from the method of service. Have the class plan one meal, then go through the form of serving that meal at a table. In the absence of a table the top of the desks can be used for a table. Later in the course the teacher should plan to combine this lesson with a cooking lesson and have the food served. In each cooking lesson suggestions for the service of the food should be made and each cooked dish should be carefully served. Interest in this lesson may be increased by allowing the children to make original menus, and if they are having some lessons in drawing, simple menu cards may be planned and executed.

LESSON IX. MILK.

Care, Cost, and Food Value of Milk. Value and Use of Sour Milk—Cottage Cheese, Clabber. Rice or Cornstarch Pudding (Plain, Caramel, or Chocolate).

SUBJECT MATTER.

Milk contains all the foodstuffs which the body requires, and therefore is capable of sustaining life for comparatively long periods. It is one of the most important protein foods, but it contains so small a per cent of carbohydrate (milk sugar) that for the adult it must be supplemented with carbohydrate foods. For the baby, milk is a perfect food, and it is a valuable adjunct to the diet of all children. One quart of milk should be allowed for the diet of each child daily after the twelfth month. The diet of the adult can well be supplemented by the use of milk. The greatest care should be exercised to protect milk from dust and dirt, for it is easily contaminated and may be the means of carrying disease germs to the body. The changes which milk undergoes when souring do not render it harmful to the body. For many people buttermilk is more easy of digestion than sweet milk, because of the changes produced by souring and the absence of fat. Sour milk is of value in cooking, producing a tender bread which can readily be made light by the addition of soda—one teaspoon of soda to 1 pint of sour milk that has clabbered.

In the preparation of cheese, the whey is separated from the curds, thus extracting most of the water, sugar, and salts, and leaving a substance rich in protein and fat. Cheese is of value in cooking, for it increases the food value of those foods to which it is added.

PRELIMINARY PLAN.

The teacher should make inquiries a few days in advance to be sure that 1 quart of sour milk can be secured, and when it is brought, she should examine it to see that it is in proper condition to make cottage cheese. She should arrange to have about 1 quart of sweet milk brought and such other supplies as are necessary for the pudding.

Opportunity can be found to discuss the use of left-over cereal by the preparation of the rice pudding, if the teacher provides some cold cooked rice for the lesson. In the absence of cold rice, the cornstarch pudding can be prepared.

RECIPES.

Cottage Cheese.

Heat sour milk slowly until the whey rises to the top, pour the whey off, put the curd in a bag and let it drip for six hours without squeezing. Put the curd into a bowl and break fine with a wooden spoon; season with salt, and mix into a paste with a little cream or butter. Mold into balls, if desired, and keep in a cold place. (It is best when fresh.)

See Farmer's Bulletin No. 363, The Use of Milk as Food; No. 487, Cheese and its Economical Uses in the Diet.

Rice Pudding.

½ cup boiled rice.
2 cups milk.
2 eggs.
⅓ cup sugar.
⅛ teaspoon salt.
½ teaspoon vanilla.

Scald the milk and add the rice, heat until rice is soft; add well-beaten yolks of eggs, sugar, and salt; cook three minutes, over water; remove from fire; add the well-beaten whites and flavoring, and serve cold. Serves 8.

Cornstarch Pudding.

¼ cup sugar.
5 tablespoons cornstarch, or ½ cup flour.
1 teaspoon vanilla, or other flavoring.
3 cups milk.
1 egg.

Combine sugar and cornstarch thoroughly. Add one cup cold milk and stir until smooth. Heat remainder of the milk, add cornstarch mixture slowly and stir until it begins to thicken. Continue cooking over hot water 20 minutes. Beat egg well, add hot pudding slowly, strain, and cool. Serve with milk or cream and sugar. (Egg may be omitted, if desired.) Serves 8.

For chocolate cornstarch pudding, use ¼ cup sugar additional and two squares Baker's chocolate. Melt chocolate carefully, add sugar, and add to cornstarch mixture.

For caramel cornstarch pudding, use two cups brown sugar and one cup boiling water. Heat sugar until it becomes a light-brown liquid; add boiling water and stir until sugar is all dissolved. Let cool; then add to cornstarch mixture.

METHOD OF WORK.

As soon as class meets demonstrate the method of making cottage cheese. Show separation of curd and whey by adding vinegar or lemon juice to sweet milk. While cheese is draining, make assignments and have the rice or cornstarch pudding made.

Emphasize the use of protein foods in this lesson and in those following.

Discuss food value of milk and its use in cooking. Discuss the food value and purposes for which skimmed milk and sour milk can be used in cooking.

Use the cottage cheese and the pudding for the school lunch.

LESSON X. SOUPS.

Cream Soups. Cream of carrot, potato, or onion soup, green pea soup or cowpea soup. Toast, croutons, or crisp crackers to serve with soup.

SUBJECT MATTER.

Cream soups.—The strained pulp of cooked vegetables, greens, or cereals, with an equal portion of thin white sauce, is the basis for cream soups.

A binding of butter and flour is used to prevent a separation of the thicker and the thinner parts of soup. This is combined as for white sauce and poured into the rest of the hot liquid just before the soup is to be served. The soup should not be allowed to boil after the vegetable pulp and milk have been combined, but kept hot over hot water. The acid present in nearly all vegetables is very apt to produce a curdling in the milk if too high a temperature is maintained after they are combined.

Two tablespoons of flour to each quart of soup is a good proportion to observe for thickening all vegetable soups that are not of a starchy nature; half that amount will be sufficient for soup prepared from a very starchy vegetable.

Attractive cream soups can be prepared from left-over vegetables and a combination of flavors may give good results.

Accompaniments.—Crisp crackers, croutons, soup sticks, or bread sticks are served as accompaniments with cream soups and are valuable because they necessitate thorough mastication, thus inducing the flow of the saliva and aiding in the digestion of the starchy ingredients of the soup.

PRELIMINARY PLAN.

The teacher should secure a vegetable that the girls have for use in their own homes as a basis for the soup, and crackers or bread to serve with the soup.

If dried peas are used, they should be put to soak the night before and put on to cook early in the morning.

It will be well to have the cooking of the carrots begun before the lesson period. If the carrots are cut up in small pieces, they will cook more quickly.

RECIPES.

Cream of Carrot Soup.

1 pint carrots, sliced.	1½ quarts hot milk.
2 tablespoons butter.	2 teaspoons salt.
4 tablespoons flour.	⅛ teaspoon pepper.

Cook carrots until very tender in enough boiling water to cover, then rub all through a strainer with a wooden spoon.

Heat butter, add flour and then the carrot mixture, and when it boils well, add hot milk and seasonings. Serve at once. Serves 6.

Cream of Potato Soup.

1 pint milk or milk and water.	1 tablespoon flour.
2 teaspoons chopped onions.	1 teaspoon salt.
3 potatoes.	⅛ teaspoon pepper.
1 tablespoon butter.	2 teaspoons chopped parsley.

Heat the milk over hot water. Add the chopped onions. Boil the potatoes until soft; drain, mash, and add the hot milk. Strain. Melt the butter, add the flour and seasonings and the potato mixture slowly. Cook 5 minutes; add the chopped parsley and serve at once. Serves 4.

Cream of Onion Soup.

3 large onions.	2 teaspoons salt.
3 tablespoons butter.	⅛ teaspoon pepper.
½ cup flour.	1 quart milk or water.

Chop or slice onions, add the hot butter, and fry to a red brown. Add flour and seasonings and cook until slightly brown. Add hot liquid and cook to a creamy consistency. Strain, reheat, and serve. Serves 8.

Green Pea Soup.

1 pint or 1 can peas.
1 quart water.
1 pint milk or cream.
2 tablespoons butter.
2 tablespoons flour.
½ teaspoon salt.
1/16 teaspoon white pepper.
½ teaspoon sugar.

Wash the peas and cook until soft in one quart of boiling water. Mash them in the water in which they were cooked, strain, and add the milk or cream; melt butter, add flour and seasoning, then the liquid, and cook until of creamy consistency. If the peas are fresh, some of the pods may be cooked with them. Serves 8.

Pea Soup.

1 cup split peas or cowpeas.
2½ quarts water.
2 tablespoons chopped onion.
3 tablespoons butter.
3 tablespoons flour.
1½ teaspoons salt.
⅛ teaspoon pepper.
1 pint milk.

Wash the peas and soak them over night in cold water; drain and rinse thoroughly; add 2½ quarts of cold water and the onion; cook slowly until soft; rub through a strainer and add the remainder of the liquid; melt butter, add flour and seasonings, then hot milk with the liquid from the peas, and cook until it is like thick cream. Cooking a ham bone with the soup improves the flavor. Serves 6 to 8.

Toast.

Cut stale bread into slices one-fourth inch thick; put on the toaster or fork, move gently over the heat until dry, then brown by placing nearer the heat, turning constantly. Bread may be dried in oven before toasting. Hot milk may be poured over dry toast.

Croutons.

Cut stale bread into one-half-inch cubes and brown in the oven.

Crisp Crackers.

Put crackers in oven for a few minutes or split and butter thick crackers and brown in a hot oven; serve with soup.

METHOD OF WORK.

Devote a few minutes to a discussion of cream soups and a review of the cooking of vegetables and white sauce.

Divide the work among the members of the class, assigning enough to each girl to keep her busy and arranging the work so that the soup and its accompaniments will be ready for serving at the same time.

LESSON XI. EGGS.

Food value and general rules for cooking eggs. Cooked in shell, poached, scrambled, and omelet.

SUBJECT MATTER.

Eggs are a very valuable food because of the large amount of protein and fat they contain. Though lacking in carbohydrates, they furnish material for building up the muscles and provide heat and energy to the body. If cooked at a low temperature, eggs are very easily and very completely digested. Combined with other foods they serve as thickening (for sauces and soups) and as a means of making batters light (popovers and sponge cake). They add flavor and color and increase the nutritive value of other foods.

See Farmers' Bulletin No. 128, Eggs and their Uses as Food.

PRELIMINARY PLAN.

The lesson on eggs furnishes one of the best opportunities to teach the muscle-building foods. If eggs are scarce, it may be well to give this lesson at some other time in the course. Each pupil should be asked to bring an egg; one or two should bring a little milk; and enough bread should be provided to toast for the poached eggs. The teacher should not undertake to give too many recipes in this lesson, but should try to acquaint the girls with a sufficient variety of ways of cooking eggs to make egg cookery interesting. A moderate temperature for cooking eggs should be emphasized.

RECIPES.

Soft-Cooked Eggs.

Put the eggs in boiling water sufficient to cover, remove from the fire, cover, and allow them to stand from 5 to 8 minutes.

Hard Cooked Eggs.

Put the eggs in cold water, heat, and when the water boils, reduce heat and let them stand 20 minutes with water just below the boiling point, then put into cold water.

Poached Eggs.

Break each egg into a saucer carefully, slip the egg into boiling water, decrease heat, and cook 5 minutes or until the white is firm, and a film has formed over the yolk. Take up with a skimmer, drain, trim off rough edges, and serve on slices of toast. Season.

Poached eggs are attractive covered with white sauce to which chopped parsley has been added.

Baked eggs.

Line a buttered baking dish with buttered bread crumbs, break eggs in dish without separating, add one tablespoon milk or cream for each egg. Season with salt and pepper, and sprinkle with grated cheese, if desired; or the dish may be lined with cold mashed potatoes. Bake in a moderate oven until eggs are set.

Creamed Eggs.

- 3 hard cooked eggs.
- 1 cup medium white sauce.
- 6 slices toast.

Prepare white sauce and add hard cooked eggs cut in halves, sliced, or chopped, and when hot serve on toast.

Or separate whites and yolks, chop whites fine, add to white sauce, and when hot serve on toast and garnish with yolks run through sieve or ricer. Season with salt and pepper. Serves 4 to 6.

Creamy Omelet.

1 egg.	Pepper.
⅛ teaspoon salt.	½ teaspoon butter.
1 tablespoon milk.	

Beat egg slightly, add milk and seasonings; put butter in hot omelet pan, when melted turn in the mixture; as it cooks draw the edges toward the center until the whole is of a creamy consistency; brown quickly underneath· fold and turn onto a hot platter. Serve at once. Serves 1.

Scrambled Eggs.

Double the quantity of milk given for creamy omelet and stir all the time while cooking

Foamy Omelet.[1]

1 egg.	1 tablespoon milk or water.
⅛ teaspoon salt.	½ teaspoon butter.
Cayenne or white pepper.	

Beat the yolk of the egg until creamy, add seasoning and milk; beat the white until stiff, but not dry, cut and fold into the yolk carefully; heat an omelet pan, rub bottom and sides with the butter, turn in the omelet, spread it evenly on the pan. Cook gently over heat until omelet is set and evenly browned underneath; put it into a hot oven for a few minutes to dry slightly on top; fold and serve immediately. Serves 1.

METHOD OF WORK.

Devote one-half the class period to a discussion of the structure of the egg and the effect of heat upon it. Use simple experiments or watch the poached egg to make a study of the changes produced in the egg by heat. If girls are sufficiently experienced, have them work together in small groups, first scrambling an egg, then making an omelet. Demonstrate the cooking of the omelet before the entire class. Serve the egg dishes carefully while hot.

LESSON XII. SIMPLE DESSERTS—CUSTARDS.

SUBJECT MATTER.

A custard is a combination of eggs and milk, usually sweetened and flavored and either steamed or baked as cup custard, or cooked in a double boiler as soft custard. The whole egg may be used or the yolks alone. The yolks make a smoother, richer custard.

The egg must be thoroughly mixed, but not beaten light, the sugar and salt added and the milk scalded and stirred in slowly. The custard must be strained through a fine sieve and cooked at a moderate temperature. It is desirable to strain a custard in order to remove the bits of membrane present from about the yolk. The cup custard should be strained before cooking, the soft custard may be strained after cooking.

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[1] The omelet recipes given are for individual portions. To make a large omelet, multiply quantity of each ingredient by number of eggs used. The best results will be obtained by making an omelet of not more than four eggs, as larger omelets are difficult to cook thoroughly and to handle well. A two-egg omelet will serve three people. A four-egg omelet will serve six people.

A soft custard is cooked over water and is stirred constantly until done. When done, the froth disappears from the surface, the custard is thickened and coats the spoon and sides of the pan, and there is no sign of curdling. If the custard is cooked too long, it becomes curdled. If a custard becomes curdled, put it into a pan of cold water and beat until smooth.

A steamed or baked custard is done when it becomes set and when a silver knife will come out clean after cutting it.

PRELIMINARY PLAN.

This lesson will furnish opportunity for review of milk and eggs. The pupils can plan to bring the necessary materials from their homes.

RECIPES.

Steamed Custards.

1 quart milk (heated).
4 eggs or 10 egg yolks.
½ cup sugar.
¼ teaspoon salt.
2 tablespoons caramel or
½ teaspoon nutmeg.

Beat eggs sufficiently to mix them thoroughly; add sugar, salt, and hot milk slowly. Strain into cups, flavor with caramel, or sprinkle nutmeg on top, and steam until firm over gently boiling water, 20 to 30 minutes.

Baked Custards.

Prepare as steamed custards, set in pan of hot water, and bake in slow oven until firm; 20 to 40 minutes.

Chocolate Custards.

Use recipe for steamed custards, adding 1 ounce chocolate (melted) to the hot milk. Steam or bake as desired.

Soft Custard.

1 pint milk (heated).
4 egg yolks.
4 tablespoons sugar.
1/16 teaspoon salt.
½ teaspoon vanilla extract.

Beat egg yolks sufficiently to mix them thoroughly, add sugar, salt, and hot milk slowly. Cook over water that is boiling gently. Stir constantly until the custard thickens. Strain. Flavor when cool.

For soft chocolate custard add ½ ounce chocolate (melted) to the hot milk. Serves 6.

Floating Island.

Use recipe for soft custard and when cold garnish with a meringue made according to the following recipe:

Meringue.

4 egg whites.
¼ cup powdered sugar.

Beat egg whites very light, add powdered sugar and continue beating. Drop in large spoonfuls on cold custard. Serves 8 to 10.

METHOD OF WORK.

It may be possible to teach two or three recipes in this lesson. The cup custard can be put into the oven while the soft custard or floating island is being made. Serve at the school lunch.

LESSON XIII. BATTERS.

Corn Bread and Hoecake.

SUBJECT MATTER.

Batters.—Batters are mixtures of flour or meal and a liquid, with salt or sugar to give flavor, butter to make tender, and air or gas to make light.

One scant measure of liquid is used with one measure of flour for thin or pour batter. One measure of liquid is used with two measures of flour for a thick cake or drop batter. One measure of liquid is used with three measures of flour for a soft or bread dough. One measure of liquid is used with four measures of flour for a stiff or pastry dough.

Before mixing a batter the oven or griddle should be at the proper temperature, with the fire well regulated and in good condition. The oven should be tested by putting in a piece of white paper or two tablespoons flour which should brown in three minutes. The pans should be prepared by greasing with lard, salt pork, or beef dripping. All materials should be measured and ready before beginning to combine ingredients. When the batter has been combined and beaten until smooth, it should be baked at once.

PRELIMINARY PLAN.

The teacher will be better prepared to give the lessons on batters if she first acquaints herself with the kinds of breads that are used in the homes and the methods followed in their preparation. The simple general methods of preparing batters should be taught. The teacher should not attempt the preparation of more than one or two batters in the lesson. Corn bread and hoecake can be made in the same lesson, since the first is made in the oven and the second cooked on a griddle on top of the stove.

RECIPES.

Corn Bread.

1 cup scalded milk.
½ cup white corn meal.
1 teaspoon salt.

Add salt to corn meal and pour the milk on gradually. Turn into a well-greased shallow pan to the depth of one-fourth inch. Bake in a moderate oven until crisp.

Hoecake.

1 cup white corn meal.
Boiling milk or water enough to scald.
½ teaspoonful salt.

Make the batter thick enough not to spread when put on the griddle. Grease the griddle with salt pork, drop the mixture on with a large spoon. Pat the cakes out till about half an inch thick; cook them slowly, and when browned put a bit of butter on the top of each cake and turn it over. Long cooking is desirable, but be careful that they do not burn.

METHOD OF WORK.

Discuss batters briefly. Have all measurements made, fire regulated, pans prepared, etc. Demonstrate combining of corn bread, put it in the oven, and while it is cooking demonstrate combining and cooking of hoecake. Serve the breads nicely after they are cooked.

LESSON XIV. BATTERS (continued).

Egg Corn Pone or Corn Muffins—Baking Powder Biscuits.

SUBJECT MATTER.

Methods of making batters light.—Batters are made light by beating air into them, by adding eggs into which air has been beaten, or by entangling gas in the batter. Gas is secured by using soda and sour milk in a batter (1 teaspoon of soda to 1 pint of sour milk), or soda with molasses (1 teaspoon of soda to 1 cup of molasses), or soda with cream of tartar (1 teaspoon of soda with 2 slightly rounding teaspoons of cream of tartar). The soda should be combined well with the other dry ingredients, then the sour milk or molasses added, the whole beaten up quickly and baked at once.

Baking powder is a preparation containing soda and cream of tartar, and can be used in place of soda if sweet milk is used. Two level teaspoons of baking powder should be used with one cup of flour.

PRELIMINARY PLAN.

This lesson is a continuation of the lesson on batters. Care should be taken not to undertake more than can be done nicely in time available.

RECIPES.

Egg Corn Pone.

1 cup white corn meal.
1 teaspoon salt.
1 teaspoon soda.
1 egg.
1 pint sour milk.
1 tablespoon melted butter, lard, or other fat.

If sweet milk is used, omit the soda and use 2 level teaspoons baking powder. Sift together corn meal, salt, and soda, add the egg well beaten, then the milk and melted butter. Beat thoroughly, put into a shallow, well greased dish, preferably earthen, granite, or iron, and bake 30 to 35 minutes in a hot oven.

Corn Muffins.

1 cup flour.
½ cup corn meal.
3 teaspoons baking powder.
1 tablespoon sugar.
½ teaspoon salt.
1 cup milk.
1 egg.
2 tablespoons butter.

Mix and sift dry ingredients. Add egg and milk beaten together. Add melted butter last. Bake in gem pans or muffin tins 25 to 30 minutes. Serves 12 to 16.

Baking-Powder Biscuits.

2 cups flour.
4 teaspoons baking powder.
1 teaspoon salt.
2 tablespoons fat.
¾ to 1 cup milk or water.

Mix dry ingredients, chop fat into the flour with a knife, slowly add sufficient milk to make a dough not too soft to be handled. Toss and roll dough gently on a slightly floured board, and cut into small biscuits. Moisten tops with a little milk. Handle dough quickly, lightly, and as little as possible. Place on a buttered sheet. Bake in a hot oven till brown, from 12 to 15 minutes. Either white or whole wheat flour may be used for biscuit. Serves 6 to 8. Oven test—oven should be hot enough to color a piece of unglazed white paper to golden brown in one minute.

Soda Biscuits.

1 pint flour.
½ teaspoon soda (scant).
2 tablespoons shortening (lard or other fat).
½ teaspoon salt.
1 cup sour milk (scant).

Proceed as for baking-powder biscuits.

If the sour milk is not thich enough to clabber, it will not contain sufficient acid to neutralize the soda and the biscuits will be yellow and bitter. To avoid this, cream of tartar can be combined with the soda (1 teaspoonful). If there is no cream of tartar at hand, it will be wise to use the recipe for baking-powder biscuits.

METHOD OF WORK.

Have oven and pans prepared and all measurements made. Demonstrate the combining of the corn pone, and while that is baking, demonstrate the combining of the biscuits. Have one girl take charge of the baking of the corn pone and another girl take charge of the baking of the biscuits. When the breads are done, have the girls sit down and serve them to one another, or to all the pupils at the school lunch hour.

LESSON XV. MEAT.

Composition and food value. How to make tough cuts of meat palatable. Pork chops with fried apples. Beef or mutton stew with vegetables and dumplings. Rabbit stew. Bacon.

SUBJECT MATTER.

Meats are rich in protein and usually in fats, but are lacking in the carbohydrates. They build up the muscular tissue, furnish heat and energy, are more stimulating and strengthening than any other food, and satisfy hunger for a greater length of time. For the most part, meats are a very expensive food. One can not perform more labor by use of a meat diet than on a diet of vegetable foods. Those who use large quantities of meat in their diet suffer from many disturbances of the system. Hence, meats should form a very small part of the diet. The cuts of meat that come from those portions of the animal's body that are much exercised are tough, owing to the development of the fibers, but they contain a high percentage of nutrition. The flesh of chickens, turkeys, and other fowls is very nutritious and is easily digested, if not too fat. In the older birds it may become very tough.

The flavor of meats is developed by cooking. Dry heat develops the best flavor, hence the tender cuts are cooked by the processes known as broiling and roasting. Tough cuts of meat require long, slow cooking in moist heat, hence they are prepared in the form of stews and pot roasts or used in meat soups.

PRELIMINARY LESSON.

After the teacher has found out what meats are used in the homes or what they can afford to use, she should determine upon a recipe that will help to make the meat palatable, digestible, and attractive. If it can be prepared as a stew, she should use a recipe in which vegetables are also used, and if possible have dumplings prepared to serve with the meat, as a review of the lesson on batters.

RECIPES.

Beef or Mutton Stew.

2 lbs. beef or mutton.
1 quart water.
Salt, pepper, flour to dredge.
1 onion, cut in slices.
½ cup turnip, cut in dice.
¾ cup carrot, cut in dice.
4 potatoes, cut in ½-inch slices.
1 teaspoon salt.
¼ teaspoon pepper.
½ cup flour.
¼ cup cold water.

Remove fat and cut the meat into 1-inch pieces. Reserve half of the best pieces of meat, put the rest of the meat and the bone into cold water, soak for one hour, then heat until it bubbles. Season half the raw meat and roll it in the flour; melt the fat in a frying pan, remove the scraps, brown the sliced onion, and then the floured meat in the hot fat; add both to the stew and cook for two hours at a low temperature. To this add the vegetables and cook one-half hour, then add the flour and seasonings, which have been mixed with one-half cup cold water, and cook for one-half hour longer until the meat and vegetables are tender. Remove the bone from stew and serve. Serves 6 to 8.

Rabbit.

If beef and mutton are not commonly used and are not readily obtainable, but rabbit can be secured, substitute rabbit for beef in the stew. After the rabbit has been thoroughly cleaned, cut up in eight pieces (four leg and four body pieces), season, and dredge with flour, brown in fat and proceed as with beef stew.

Dumplings.

2 cups flour.
4 teaspoons baking powder.
½ teaspoon salt.
2 tablespoons fat (lard or butter).
¾ cup milk or water (about).

Sift dry ingredients together, cut in the butter, and add milk gradually to make a soft dough. Roll out on a floured board, cut with a biscuit cutter, lay on top of meat in stew pan (they should not sink into the liquid), cover kettle closely, keep stew boiling, and cook dumplings 10 minutes without removing lid. (Do not put dumplings in to cook until meat is tender.)

To Cook Bacon.

Place thin slices of bacon (from which the rind has been removed) in a hot frying pan and pour off the fat as fast as it comes out. When the bacon is crisp, drain on paper. Keep hot. Or lay bacon on a rack in a baking pan and bake in a hot oven until crisp.

Pork Chops.

Wipe the chops with a damp cloth, sprinkle with salt and pepper, place in a hot frying pan, and cook slowly until tender and well browned on each side. Pour the fat out of the pan as fast as it is melted.

Fried Apples.

Wash apples and slice to the center, removing the core. Roll in flour if very juicy. After the chops have been removed from the pan, lay the apples in and cook till tender. Serve around the chops.

See Farmers' Bulletins No. 34, Meats: Composition and cooking; No. 391, Economical use of meat in the home.

METHOD OF WORK.

If the meat is to require two or three hours' cooking, arrange to have the lesson divided and given at two periods through the day. A half hour before opening the morning session or a portion of the morning or noon recess may be sufficient to put the meat on to cook and to prepare the vegetables. When the second class period is called, the vegetables should be added to the partially cooked meat and the dumplings made. It would be well to serve the completed dish at the lunch period. There should be as much discussion of the kinds of meat, their food value, and methods of cooking as time permits, but it may be necessary to complete these discussions at some other class periods.

Should it be possible for the teacher to give additional lessons on meat, it may be well to devote one lesson to the preparation and cooking of poultry, directions for which can be easily secured from reliable cookbooks.

LESSON XVI. BAKED PORK AND BEANS, OR BAKED COWPEAS—CORN-DODGERS.

SUBJECT MATTER.

Peas, beans, and lentils which are dried for market contain a high percentage of protein, carbohydrate, and mineral matter. They form an excellent substitute for meat and are much cheaper in price. Their digestion proceeds slowly, involving a large amount of work; so they are not desirable food for the sick, but are satisfactory for those who are well and active. The dried legumes must be soaked overnight in water, when cooked for a long time, to soften the cellulose and develop flavor.

PRELIMINARY PLAN.

It will be necessary to plan this lesson several days in advance if the beans are to be baked. As they will be prepared and put on to bake before the lesson period, the corndodgers can be made to serve with them.

RECIPES.

Corndodgers.

2 cups fine white corn meal.	½ teaspoon salt.
Boiling water to moisten.	2 or 3 tablespoons milk.
1 teaspoon fat.	2 eggs.
1 teaspoon sugar.	

Pour boiling water over the meal so that it is all wet but not soft; add fat, sugar, salt, and milk; when cold add the eggs, yolks and whites beaten separately. The batter should drop easily from the spoon, but it should not be thin enough to pour nor stiff enough to require scraping out. It should be shaped in oval shapes on a pan that is well greased and hissing hot, and the oven should be as hot as possible. Bake until brown and puffy.

Boston Baked Beans.

1 quart navy beans.	2 tablespoons molasses.
1 tablespoon salt.	1 cup boiling water.
½ tablespoon mustard.	½ pound fat salt pork.
3 tablespoons sugar.	Boiling water to cover.

Look over the beans and soak in cold water overnight.

In the morning drain, cover with fresh water, and heat slowly until skins will burst, but do not let beans become broken.

Scald one-half pound fat salt pork. Scrape the pork. Put a slice of pork in bottom of bean pot. Cut the remaining pork across top in strips just through the rind, and bury pork in beans, leaving rind exposed.

Add one cup boiling water to seasonings and pour over the beans. Cover with boiling water. Bake slowly, adding more water as necessary. Bake from six to eight hours, uncover at the last, so that water will evaporate and beans brown on top. Serves 12.

See Farmers' Bulletin No. 256, The preparation of vegetables for the table.

Baked Cowpeas.

Cook 1 quart of large white cowpeas slowly in water until they begin to soften. This will require five or six hours. Put them into a bean pot, add one-half pound of salt pork and one tablespoonful of molasses. Cover with water and bake slowly six or seven hours. It is well to have the pot covered except during the last hour.

See Farmers' Bulletin No. 559, Use of corn, kafir, and cowpeas in the home.

METHOD OF WORK.

Have the beans washed and put to soak the night before the lesson is to be given. Assign to one of the girls the task of putting them on to boil early the next morning. Call the class together for a few moments when the beans are ready to put in to bake. Assign one of the girls to attend to the fire and the oven. Let the beans bake all day. If the lesson is to be given late in the afternoon, the beans may be ready to serve, or the cooking may be continued the second day and the lesson completed then. It would be well to serve the dish at the lunch period. Have the corndodgers prepared to serve with the baked beans or cowpeas.

LESSON XVII. BUTTER CAKES—PLAIN YELLOW CAKE—COCOA—COFFEE—TEA.

SUBJECT MATTER.

Cakes.—Cakes made with fat resemble other batters, except that the fat, sugar, and eggs are usually larger in amount and the texture of the baked batter is much finer and more tender.

When preparing cake, first get the pans ready, greasing them with the same kind of fat that is to be used in the mixture, or sprinkle with flour, or line with greased paper. Make sure that the oven is at the proper temperature. For a small cake the oven should be hot enough to brown a small piece of unglazed paper or a tablespoon of flour in three minutes. Bake a small cake 20 to 30 minutes. When done, the cake will shrink from the sides of the pan; the crust will spring back when touched with the finger; the loud ticking sound will cease; a needle or straw will come out clean if the cake is pierced, and the crust will be nicely browned. When the cake is removed from the oven, let it stand in the pan about three minutes, then loosen and turn out gently. Do not handle while hot. Keep in a clean, ventilated tin box in a cool, dry place.

Cocoa.—Chocolate and cocoa are prepared from the bean of a tropical tree. This bean is rich in protein, fat, carbohydrate, mineral matter, and a stimulant called theobromine. The seeds are cleaned, milled, and crushed into a paste in the preparation of chocolate. In the preparation of cocoa much of the fat is removed and the cocoa is packed for market in the form of a fine powder. Cocoa is more easy of digestion than chocolate, because it is less rich. Though the amount of cocoa used in a cup of the beverage is not large, when prepared with milk it serves as a nutritious food. It is slightly stimulating as well, because of the theobromine present and because it is served hot.

Coffee and Tea.—Coffee and tea have no food value when prepared as a beverage. They contain stimulating properties that are harmful to the body if taken in large quantities, hence they should be used with discretion. They should never be given to children or to those troubled with indigestion. If carelessly prepared, both coffee and tea may be decidedly harmful to the body. Coffee should not be boiled for more than eight minutes. Tea should never be permitted to boil. Freshly boiling water should be poured on the leaves and left for three minutes. It should then be strained off for serving and kept hot until used.

PRELIMINARY PLAN.

It will be well to plan to give the lesson on some special occasion, as it is well adapted to serve for the refreshments for a mother's club or a little class party.

RECIPES.

Plain Yellow Cake.

½ cup butter.
1 cup sugar.
2 eggs.
½ cup milk.
2 teaspoons baking powder.
1½ cups flour.
1 teaspoon spice or
1½ teaspoons flavoring.

Cream butter, add sugar gradually, mix well. Add well-beaten yolks of eggs, then flour and baking powder alternately with the milk. Then add flavoring and cut and fold in whites of eggs carefully. Turn into buttered pans and bake at once in a moderately hot oven.

For chocolate cake 2 ounces of melted chocolate may be added after yolks of eggs. Serves 16 to 20.

Gingerbread.

¼ cup butter.
½ cup sugar.
1 egg.
½ cup molasses.
½ teaspoon soda.
1¾ cups flour.
1 teaspoon ginger.
½ teaspoon cinnamon.
Salt.
½ cup milk (sour if possible).

Cream the butter, add sugar gradually, then well-beaten egg. Add molasses. Sift all dry ingredients together, and add alternately with milk. Bake in a buttered tin or in gem pans in a moderate oven 25 or 35 minutes. Serves 8 to 10.

Cocoa.

¼ cup cocoa.
¼ cup sugar.
1 cup water.
3 cups milk.

Mix the cocoa and sugar with the water and boil 10 minutes. Stir into the hot milk and then cook in double boiler one-half hour. Serves 8 to 10.

Tea.[1]

1 teaspoon green or 2 teaspoons black tea.
2 cups boiling water (freshly boiling.)

Scald teapot, put the tea in the teapot and pour boiling water over it; steep 3 minutes, strain, and serve. Serves 4.

Coffee.[1]

Use two tablespoons of ground coffee for each cup of boiling water that is to be used. Put the coffee in the coffee pot and add enough cold water to moisten the coffee and make it stick together, about one teaspoon of water to each tablespoon of coffee. Pour the boiling water over the coffee and boil it for 3 minutes. Place it where it will keep hot, but not boil, for 5 minutes or more, and then serve. (If a small amount of egg white and shell is mixed with the coffee grounds and cold water it will aid in settling the coffee.)

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[1] The recipes for coffee and tea are given so that the teacher can discuss their preparation with the girls and compare their value with the value of cocoa. If coffee and tea are both commonly used in the homes, it may be well to have the girls prepare them in the class, to be sure that they appreciate the importance of proper cooking.

METHOD OF WORK.

Begin the lesson period with a discussion of the methods of preparing cakes and put the cake in the oven as soon as possible. While it is baking prepare the cocoa. If the cocoa is not to be served for some time, it can be kept hot or reheated over hot water.

LESSON XVIII. YEAST BREAD.

SUBJECT MATTER.

Yeast bread is made light by the presence of a gas produced by the growth of yeast in the sponge or dough. Yeast is a microscopic plant which grows in a moist, warm temperature and feeds on starchy materials such as are present in wheat. A portion of the starch is converted into sugar (thus developing new and pleasant flavors), and some is still further changed, giving off the gas upon which the lightness of the bread depends. If the yeast is allowed to grow too long a time or the temperature is very hot, a souring of the dough may result. This souring can be prevented by kneading the dough thoroughly as soon as it has risen well or doubled in bulk or by putting it in a very hot oven to bake when it has reached this stage. If the dough becomes chilled, the yeast will not grow so well, and if the temperature of the dough should become hot the activities of the yeast would become arrested. A boiling temperature will destroy the growth of the yeast.

Yeast develops in a natural state on the hops and other plants. It is prepared for market in the form of dry or moist cakes. The moist cakes must be kept very cold. For home use a liquid yeast is often prepared from the dry cakes. This has the advantage of being more active.

When the yeast has been added to a batter it is spoken of as a sponge. When the batter has had enough flour added so that it can be handled it is called a dough. If the bread is to be made in a few hours, the yeast is made up at once into a dough. If it is to stand overnight, a sponge is often started first. More yeast is required for quick rising. Under ordinary circumstances one yeast cake is sufficient for 1 quart of liquid. Thorough kneading and baking are both essential to the success of the bread.

PRELIMINARY PLAN.

Arrange to have the class meet the afternoon before to start the sponge and come early in the morning to care for the dough. Begin the study of flour, yeast, and bread in a previous class period, correlating the work with geography, nature study, or some other subject. Either white or whole-wheat flour may be used for the breads.

RECIPES.

Bread.

(Prepared with dry yeast.)

1 dry yeast cake.	2 teaspoons salt.
1 cup warm water.	2 tablespoons sugar.
1 cup flour.	2 tablespoons lard or butter.
1 quart water or milk (scalded).	
Flour enough to make a soft dough.	

At noon put a dry yeast cake to soak in a cup of warm water. When it is soft, add a cup of flour, cover, and put in a warm place to grow light. This will require several hours.

In the evening when ready to start the dough, mix salt, sugar, fat, and hot liquid in a large bowl; when lukewarm add the cup of light yeast and enough flour to knead (about three quarts). Mix thoroughly and knead it into a smooth dough, and continue until it is soft and elastic. Return dough to the bowl, moisten, cover, and set in a moderately warm place for the night. Be sure that the place is free from drafts. In the morning knead slightly; divide into loaves or shape in biscuits; put into pans for baking; cover and let rise until double in bulk. Bake large loaves 50 to 60 minutes. Biscuits will bake in from 25 to 35 minutes. for they require a hotter oven. (Makes 4 loaves). It is of utmost importance that all yeast breads be thoroughly cooked.

(Time required for making bread with dry yeast, 16 to 20 hours.)

Bread.

(Prepared with compressed yeast.)

2 cups milk or water (scalded).	½ cake compressed yeast (1 cake if set in morning.)
2 teaspoons salt.	½ cup water (lukewarm).
2 teaspoons sugar.	Flour, white or whole wheat.
1 tablespoon lard or butter.	

Put the hot water or milk, salt, sugar, and fat in a bowl; when lukewarm add the yeast softened in the lukewarm water, then the flour gradually, and when stiff enough to handle, turn dough out on floured board and knead until soft and elastic (20 minutes). Return dough to the bowl, moisten, cover, and let it rise in a warm place until double its bulk; then knead slightly, divide into loaves, or shape into biscuits, cover and let rise in the pan in which they are to be baked until double in bulk, and bake 50 to 60 minutes. (Makes 2 loaves.)

(Time required for making bread, if one cake compressed yeast is used, 6 hours.)

See Farmers' Bulletins: No. 389, Bread and bread making; No. 807, Bread and bread making in the home.

METHOD OF WORK.

If the class is large, prepare two or three bowls of sponge, so that all can have some experience in stirring and kneading. Do not make too large a quantity of bread to bake in the oven unless arrangements can be made to do some of the baking at the near-by home of one of the girls. Use the bread for the school lunch or divide it among the girls to take home.

Plan a bread contest so that each girl will be interested to make bread at home.

LESSON XIX. SERVING A SIMPLE DINNER WITHOUT MEAT. BAKED OMELET. MACARONI AND CHEESE.

PRELIMINARY PLAN AND METHOD OF WORK.

At some previous time the teacher should talk over the plans for the dinner with the girls. It will be well to let them ask the members of the school board or other people interested in their work to partake of the dinner. They should decide on the menu with help and suggestions from the teacher. They should choose foods that they can bring from their homes. The main course of the dinner should consist of such a vegetable dish as baked beans, cowpeas, an omelet, or macaroni with white sauce and grated cheese. To accompany it there should be potatoes and a fresh green vegetable, such as spinach or cabbage and a hot bread.

A simple dessert which the girls know how to make should be chosen. One duty should be assigned to each girl and she should be entirely responsible for that portion of the work. The teacher should supervise all the work carefully.

The girls may be able to make simple menu cards for the dinner. The work of making the cards can be taken up in a drawing lesson.

RECIPES.

Baked Omelet.

2 tablespoons butter.	1 cup milk, heated.
2 tablespoons flour.	4 eggs.
½ teaspoon salt.	2 teaspoons fat.
Pepper.	

Melt the butter, add the flour and seasonings, combine thoroughly, then add the hot milk slowly. Separate the eggs, beat the yolks, and add the white sauce to them. Beat the whites until stiff and cut and fold them carefully into the yolk mixture so that the lightness is all retained. Turn into a greased baking dish and bake in a moderate oven 20 to 30 minutes. Serve hot. Serves 6.

Macaroni and Cheese.

1 cup macaroni, noodles, or rice.	Pepper.
2 tablespoons fat.	1½ cups milk.
3 tablespoons flour.	1 cup grated cheese.
½ teaspoon salt.	

2 cups buttered bread crumbs (two tablespoons butter or other fat).

Break the macaroni in 1-inch pieces and cook it in a large amount of boiling water salted 30 to 45 minutes. Drain it well when tender and pour cold water through it.

Grate the cheese, break up the bread crumbs, and add two tablespoons melted butter to them. Make a white sauce of the fat, flour, seasonings, and milk. Add the macaroni and cheese to the white sauce, pour it into a butter-baking dish, cover with bread crumbs, and bake from 20 to 30 minutes in the oven, browning nicely. Serves 8.

LESSON XX. SUGAR.

Food value and cooking. The use of peanuts in candy. Peanut cookies, or peanut, molasses, or fudge candies to be made for a special entertainment.

SUBJECT MATTER.

Sugar is valuable to the body as a source of heat and energy. While it is easy of digestion, it is very irritating to the body if taken in large quantities, and hence it should be taken in small quantities and preferably at meal time or with other food. Two or three pieces of candy taken at the end of the meal will not be harmful, but candy eaten habitually between meals is sure to produce harmful effects in the body. Large quantities of candy are always disturbing to the body.

Sugar is present in many fruits and some vegetables. Milk contains a good per cent of sugar. In preparing foods to which the addition of sugar seems desirable, care should be taken not to add it in large quantities.

PRELIMINARY PLAN.

As it is desirable to have a discussion of sugar and its value to the body, the preparation of cookies or candy for some school function or Christmas party can be undertaken in conjunction with this lesson. The lesson should be given at a time when it will mean most to the girls. The work should be so planned that the girls will learn something of the principles of sugar cookery as well as the specific recipes they are using.

RECIPES.

Cookies.

1 cup fat.
1 cup sugar.
2 eggs.
¼ cup milk.
3 cups flour.
3 teaspoons baking powder.
1 tablespoon cinnamon.
½ cup sugar.

Cream the butter, add sugar and well-beaten eggs. Then add milk alternately with flour (sifted with baking powder). Mix to the consistency of a soft dough, adding more milk if necessary. Roll lightly, cut in shapes, and dip in the one-half cup sugar and cinnamon that have been sifted together. Place on buttered sheets, and bake in a hot oven about 10 minutes. Slip from pan and lay on cake cooler. To make a softer cooky, use only one-half cup butter in recipe. (3 to 4 dozen.)

Peanut Cookies.

2 tablespoons butter.
¼ cup sugar.
1 egg.
1 teaspoon baking powder.
¼ teaspoon salt.
½ cup flour.
2 tablespoons milk.
½ cup finely chopped peanuts.
½ teaspoon lemon juice.
2 dozen whole peanuts shelled.

Cream the butter, add the sugar and the egg well-beaten. Mix and sift dry ingredients, add to first mixture, then add milk, peanuts, and lemon juice. Drop from the teaspoon onto an unbuttered baking sheet, an inch apart, and place ½ peanut on top of each. Bake 12 to 15 minutes in a moderate oven. (2½ to 3 dozen.)

Peanut Brittle.

1 cup sugar.
1 cup peanuts (1 quart with shells on).

Heat sugar until it all melts and liquid becomes clear, remove immediately, add peanuts, chopped if desired, mixing them in thoroughly; quickly spread upon a smooth tin or iron sheet, press into shape with knife and cut into bars or squares. Serves ten.

Molasses Candy.

2 cups molasses.
¾ cup sugar.
2 tablespoons butter.
1 tablespoon vinegar.
½ teaspoon soda.

Put molasses, sugar, and butter into a thick saucepan or kettle, and stir until sugar is dissolved. Boil until mixture becomes brittle when tried in cold water. Stir constantly at the last to prevent burning. (Butter may be omitted if it can not be easily secured.)

Add vinegar and soda just before removing from fire.

Pour into a well-greased pan and let stand until cool enough to handle. Then pull until light and porous and cut in small pieces with scissors, arranging on buttered plates. Serves 16 to 20.

Caramel Fudge.

2 cups sugar.
1 cup milk.
½ cup caramelized sugar.
1 tablespoon butter.
½ cup nuts, broken up.

Boil sugar and milk together, add caramelized sugar and butter, and boil to the soft ball stage. Take from fire and beat until the candy becomes creamy. Add nuts and turn into buttered pans; when cool cut into squares. Serves 16 to 20.

See Farmers' Bulletin No. 535, "Sugar and its value as food."

METHOD OF WORK.

Devote a separate period to the discussion of the food value and cooking of sugar, if possible; then assign two recipes for the practical work, allowing the girls to work in groups. Assign only as much work as can be carefully supervised. Do not undertake both the cookies and the candy.

TWENTY LESSONS IN SEWING.

For the Rural Schools.

OUTLINE OF THE COURSE.

Lesson I. Preparation for sewing. Preparation and use of working equipment: Needles, pins, thread, tape measure, thimble, scissors, box for work. Talk on cleanliness and neatness (care of hands, etc.). Discussion of hemming. Hems folded on sheets of paper.

Lesson II. Hemming towels. Turning and basting hems. Hemming towels of crash, flour, or meal sacks, or other coarse material for use in washing and drying dishes at home or in school.

Lesson III. Hemming towels, continued. The overhanding stich and the hemming stitch.

Lesson IV. Bags. A school bag. Bag (made of obtainable material) to hold sewing materials or cooking apron. Measuring and straightening the material for the bag. Basting the seams.

Lesson V. Bags, continued. Sewing up the seams with a running stitch and a back stitch.

Lesson VI. Bags, continued. Overcasting the seams and turning the hem at the top of the bag.

Lesson VII. Bags, continued. Hemming the top of the bag and putting in a running stitch to provide a space for the cord.

Lesson VIII. Bags, continued. Preparing a cord or other draw string for the bag. Putting a double draw string in the bag so that it can easily be drawn up. Use of the bodkin.

Lesson IX. Darning stockings. Use of a darning ball or a gourd as a substitute for the ball. Talk on care of the feet and care of stockings.

Lesson X. Patching (used when special problem comes up). Hemming patches on cotton garments. Talk on care of clothes.

Lesson XI. Cutting out an apron (or an undergarment).[1]

Lesson XII. Apron (or undergarment), continued. Basting the hem for hemming on the machine or by hand. Uneven basting.

Lesson XIII. Apron (or undergarment), continued: Gathering the skirt and stitching to the belt.

Lesson XIV. Apron (or undergarment), continued. Making the bib.

Lesson XV. Apron (or undergarment), continued. Making the straps.

Lesson XVI. Apron (or undergarment), continued. Putting the bib and skirt on to the belt.

Lesson XVII. Methods of fastening garments. Sewing buttons on aprons, petticoats, or other garments.

Lesson XVIII. Methods of fastening garments, continued. Button holes on practice piece and on apron.

Lesson XIX. A padded holder for handling hot dishes. Binding.

Lesson XX. A cap to wear with the cooking apron.

SUGGESTIONS TO THE TEACHER.

The teacher should be well acquainted with the conditions in which the girls live, should know how much money they can afford to pay for materials, what materials are available, what previous handwork the girls have had, whether they can afford to have sewing machines in their own homes, to what extent they make their own clothes, and to what extent they buy them ready-made.

The lessons should be planned to furnish hand training, to give the instruction of which the girls can immediately make use in the care of their own clothes, and to provide opportunity for preparing the apron for the cooking lessons that are to follow. They should tend to develop habits of thrift, industry, and neatness. The girls should be encouraged to learn to sew, both to improve their own home conditions and to give them suggestion for a possible means of livelihood. If sewing machines are available and are in use in the homes represented in the school, it is well to have lessons given in machine sewing and to have the long seams run by machine. If the girls can not have sewing machines in their own homes, the lessons given should be limited to hand sewing. In some schools it may be necessary to simplify the lessons; in others an increased number of articles may be prepared in the time allotted. Should the apron and cap not be needed for the cooking class, an undergarment (petticoat) can well be substituted.

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[1] Should the teacher feel that an apron or petticoat is too large a piece for her girls to undertake, and should she desire to have more time put on the first 10 lessons, Lessons XI to XVIII may be omitted, two periods each devoted to both Lessons XIX and XX, and three lessons used for the making of a simple needle book or other small piece.

The teacher should have a definite plan of procedure in mind for each lesson. The lesson should be opened with a brief and concrete class discussion of the new work that is to be taken up or the special stage that has been reached in work that is already under way. Though individual instruction is necessary, it should not take the place of this general presentation of subject matter, which economizes time and develops the real thought content of the work.

New stitches can be demonstrated on large pieces of muslin with long darning needles and red or black Germantown yarn. The muslin may be pinned to the blackboard with thumb tacks and the stitches made large enough for all to see without difficulty. A variety of completed articles should be kept on hand to show additional application of points brought out in the lesson. Each class may be given the privilege of preparing one article to add to this collection, and a spirit of class pride and valuable team work thereby developed.

During the lesson, posture, neatness, and order should be emphasized. Application can be secured by making the problems of interest. Care must be taken that none of the work demands unnecessary eye strain. Each lesson should be closed in time to have one of the members of the class give a brief summary of the steps that have been covered.

Since the class period for sewing in the rural school will necessarily be brief, the girls can be encouraged to continue their work at some other period. However, no work outside of the class period should be permitted until the pupil has mastered the stitch and can be trusted to do the work in the right way. The privilege of sewing can be made the reward for lessons quickly learned, home practice can be assigned, or the class can meet out of school hours. All outside practice must be carefully supervised, the pupil bringing her work to the teacher for frequent inspection.

If it is possible to keep on hand a permanent equipment for sewing, the following should be provided for a class of 12:

	Approximate cost.
Scissors, 1 dozen	$3.00
Thimbles, 1 dozen	.25
Tape measures, 1 dozen	.40
Emery, 1 dozen	.40
Boxes for work, 1 dozen	.84
	4.89

The teacher who is to give lessons in sewing should secure a helpful elementary textbook on sewing or some bulletin that deals with the teaching of sewing. Such bulletins are issued in some States by the extension departments of the State university, college, or normal schools. A leaflet that will prove of value, entitled "Sewing for Rural Schools" (Vol. VII, No. 7), is published by the Hampton Normal and Agricultural Institute, Hampton, Va. It will be sent free to southern teachers upon request.

A suggestive list of textbooks on sewing, for use in elementary rural schools.

Burton, Ida R. and Myron G.—"School Sewing, Based on Home Problems." Price, $1. Vocational Supply Co., Indianapolis.

Flagg, Etta P.—"Handbook of Elementary Sewing." Price, 50 cents. Little, Brown & Co., Boston.

Fuller, M. E.—"Constructive Sewing Book I" (paper). Price, 60 cents. Industrial Book & Equipment Co., Indianapolis.

Hapgood, Olive C.—"School Needlework." Price, 50 cents. Ginn & Co., Boston.

Kinne, Helen, and Cooley, Anna M.—"Clothing and Health." Price, 65 cents. The Macmillan Co., New York City.

McGlauflin, Idabelle.—"Handicraft for Girls." Price, $1. The Manual Arts Press, Peoria, Ill.

Patton, Frances.—"Home and School Sewing." Price, 60 cents. Newson & Co. New York City.

Woolman, Mary S.—"A Sewing Course." Price, $1.50. Frederick A. Fernalu, Washington.

DETAILED LESSON PLANS FOR THE COURSE IN SEWING.

LESSON I. PREPARATION FOR SEWING.

Preparation and use of working equipment: Needles, pins, thread, tape measure, thimble, scissors, box for work. Talk on cleanliness and neatness (care of hands, etc.). Discussion of hemming. Hems folded on sheets of paper.

SUBJECT MATTER.

A hem is a fold used to finish a cut surface, made by twice turning over the edge of a piece of cloth toward the worker, and then sewing it down. In turning a narrow hem the first fold must be less deep than the second, in order that the hem may lie smoothly. If the hem is a wide one, the first fold can be much less deep than the second.

PRELIMINARY PLAN.

The teacher should have interested the children in the sewing lessons before the first meeting of the class, and each girl should be asked to come to class with the box in which to keep her materials and such other equipment as is required. If the school is to furnish the equipment, the teacher should be sure that there is an adequate amount on hand.

It will probably be necessary to have towels hemmed to be used in the cooking classes at school, and the girls should be interested in doing the hemming. If some of the girls want to hem towels for use in their own homes, it will be desirable to allow them to do so. Flour or meal sacks will answer. It may be well to have the girls each hem a towel for home use as well as for school use, in order to impress them with the desirability of having hemmed dish towels for daily use. The towels can be planned during this lesson and the girls can arrange to bring the material from home, if they are to provide them. It will be well for the teacher to have material for one or two towels already on hand. Plain paper will answer for the practice folding of the hem in the first lesson.

METHOD OF WORK.

The teacher should devote a few minutes to a talk on cleanliness, emphasizing the importance of cleanliness, and the necessity for care in handling the sewing materials. This should be followed by a discussion of the care of the hands and the condition in which the hands should be for the sewing lesson. Each girl should inspect her own hands and show them to the teacher.

When sure that all the girls have their hands in proper condition for sewing, the teacher should look over their supplies with them, give them suggestions as to how they are to keep the supplies, and have them arrange their boxes.

Next she should tell them what their first work is to be, show them the material for the towels, and discuss with them the best method of finishing the ends of the towels. (See Lesson II.)

Before turning the hem the girls should make a cardboard ruler from heavy paper and notched to indicate the depth of the hem. A few minutes should be devoted to practice in measuring and turning a hem the desired depth on a sheet of paper. This should give experience with the double turning necessary—first, the narrow turn to dispose of the cut surface; second, the fold to finish the edge.

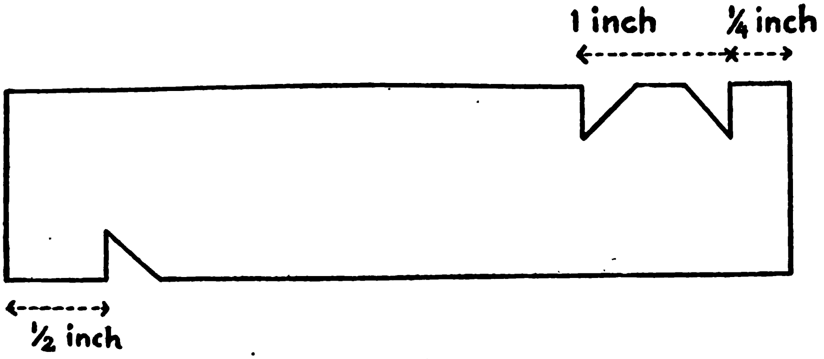

FIG. 2.—Gauge.

Careful measuring should help to give the girls practice, so that they will be able to measure with the eye a designated distance in inches or fraction of an inch.

When the lesson hour has come to an end the boxes should be put away in systematic order. All scraps should be always carefully picked up from the desks and floor.

LESSON II. HEMMING TOWELS.

Turning and basting hems. Hemming towels of crash, flour or meal sacks, or other material, for use in washing and drying dishes at home or in school.

SUBJECT MATTER.

Basting is used to hold two pieces of material together until a strong stitch can be put in. It is done by taking long stitches (one-fourth inch) from right to left and parallel to the edges that are to to be basted together. In starting the thread is fastened with a knot; when completed it is fastened by taking two or three stitches one over the other.

PRELIMINARY PLAN.

The teacher should have the necessary materials for sewing on hand, or should have them supplied by the children. The materials needed will include material for towels, white thread for basting and hemming, and cardboard pieces for measuring.

The teacher should also have a large square of unbleached muslin or canvas, 18 by 18 inches, and a large darning needle and colored worsted thread to use for demonstration purposes. The canvas should be pinned to the blackboard, where the class can see it easily.

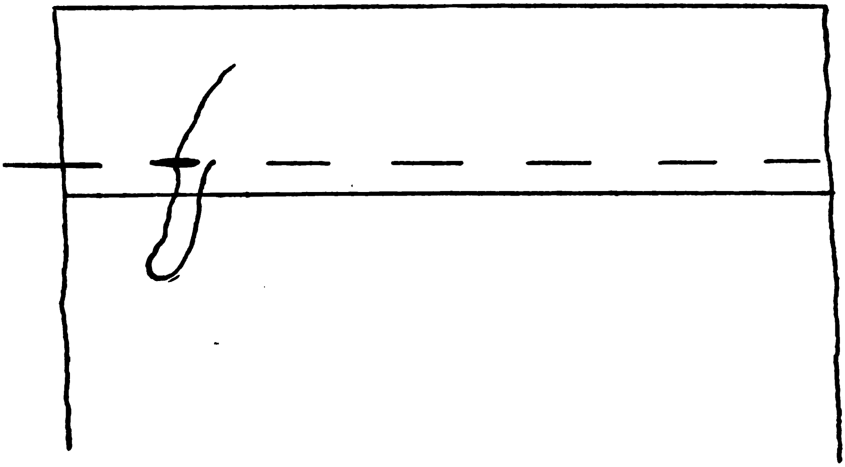

FIG. 3.—Even basting.

METHOD OF WORK.

As soon as class is called, supplies are at hand, and hands are in proper condition, the teacher should demonstrate the basting stitch with a large needle and thread on the square of canvas that has been fastened on the wall. Materials should be passed for work. Each girl should straighten the ends of her towel by drawing a thread. Then she should turn and baste a hem three-eighths of an inch in depth at each end.

At the close of the lesson the girls should fold up their work carefully and put it neatly in their boxes.

LESSON III. HEMMING TOWELS (Continued).

The Overhanding Stitch and the Hemming Stitch.

SUBJECT MATTER.

Overhanding (also called overseaming or whipping).—The edges to be overhanded are held between the first finger and thumb of the left hand with the edge parallel to the first finger. The needle is inserted just below and perpendicular to the edge. The needle is pointed straight toward the worker The stitches proceed from right to left, each stitch being taken a little to the left of the preceding stitch.

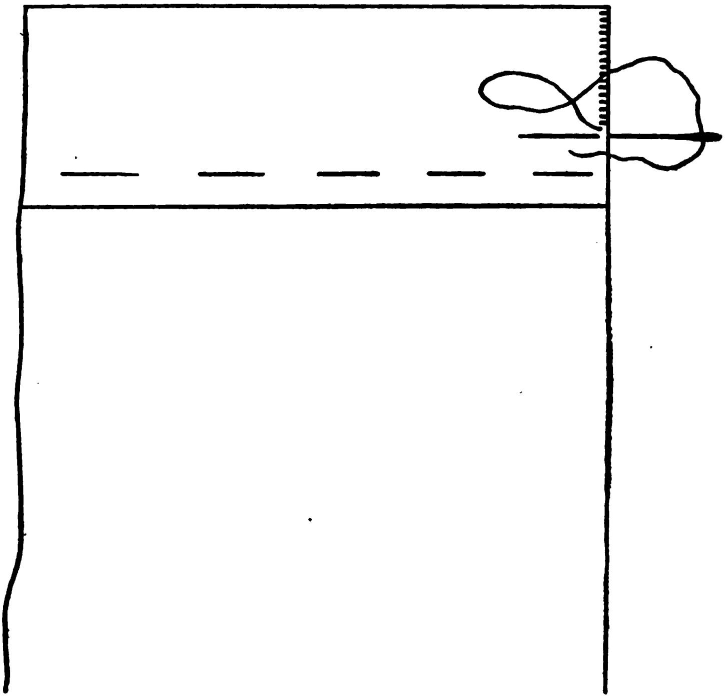

FIG. 4.—Overhanding.

The stitches should all be straight on the right side, but they will slant a little on the wrong side. The stitches should not be deep. It may be desirable to use this overhanding stitch at the ends of hems to hold the edges of the material together. The overhanding stitch is also used for seams, for patching, and for sewing on lace.

The overhanding of narrow hems is not always necessary, but the ends may be made stronger thereby, and the stitch is a valuable one for the girls to know.

Hemming.—The hemming stitch is placed on the inside of the hem. The end of the basted hem is laid over the first and under the second finger of the left hand with the folded edge outside and the material toward the worker. It is held in place with the thumb. The stitch is begun at the end of the hem. The fastening of the thread is concealed by slipping it underneath the hem in the inside fold of the material. The needle is pointed over the left shoulder, a small stitch is taken through the material just under the hem, then through the edge of the hem. This is repeated, making the next stitch nearer the worker, and moving the goods from right to left away from the worker as necessary. Uniformity of slant, size, and spacing of stitches is important.

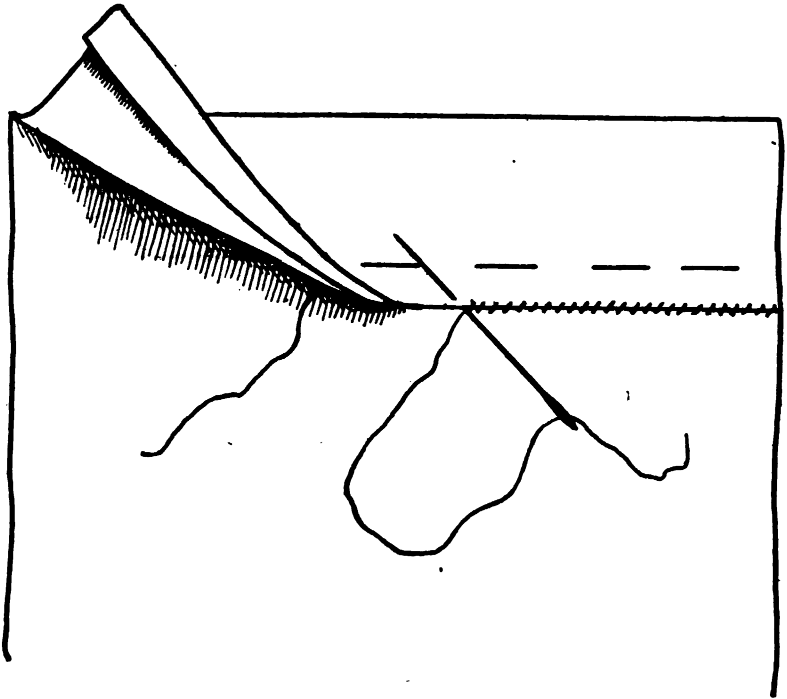

FIG. 5.—Hemming.

PRELIMINARY PLAN.

Before this lesson is given, all the girls should report to the teacher with both ends of their towels basted so that they will all be ready to proceed at once with the new stitches.

METHOD OF WORK.

The teacher should begin the lesson by demonstrating the stitches to be used on the large square of canvas, with the large needle and heavy thread. After overhanding the end of the hem, the hemming stitch should follow with the same thread. The girls will probably not be able to finish the hemming in this first lesson, so provision should be made for additional time. This can be required as an outside assignment, if they have mastered the method during the class period. The teacher may be able to give them some supervision while she is looking after other classes.[1]

LESSON IV. BAGS.

A school bag. Bag (made of material obtainable) to hold sewing materials or the cooking apron. Measuring and straightening the material for the bag. Basting the seams.

SUBJECT MATTER.

The basting stitch will be used as a review of work in the second lesson.

PRELIMINARY PLAN.

At some previous time the teacher should talk with the girls about what material they will be able to provide for their bags, and, if the material has to be purchased, she should suggest something that is suitable, washable, and inexpensive. The bag should cost only a few cents. If the bag is to be used for carrying the cooking apron back and forth from home, it must not be too light in color. The dimensions of the finished bag should be about 12 by 18 inches.

METHOD OF WORK.

The girls should get out the materials they have brought for their bags and determine upon their size and shape. It will not be necessary for them to make bags of uniform shape and size. The teacher should help them to use their material to the best advantage. The material should be straightened, pulled in place, and measured carefully. When the bags have been cut out, the sides should be basted up.

LESSON V. BAGS (Continued).

Sewing up the seams with a running stitch and a back stitch.

SUBJECT MATTER.

Running is done by passing the needle in and out of the material at regular intervals. Small, even stitches and spaces should follow consecutively on both sides of the material. The stitches should be much shorter than for basting, the length being determined largely by the kind of cloth used.

When running is combined with a back stitch, two or more running stitches and one back stitch are taken alternately. The back stitch is a stitch taken backward on the upper side of the cloth, putting the needle back each time into the end of the last stitch and bringing it out the same distance beyond the last stitch.

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[1] If the girls have time to do more hemming than the towels require, they may enjoy making simple curtains of plain mull or dotted swiss for the windows of the schoolroom. This work can be taken up in additional lesson periods or after school hours.

PRELIMINARY PLAN.

The teacher should be sure that all the teachers are ready to report, with the sides of their bags basted ready for stitching.

METHOD OF WORK.

The teacher should first demonstrate the running stitch with the back stitch, and the girls should begin to sew up the sides of the bag, using the running stitch. They should commence the running stitch at three-fourths of an inch from the upper end of the bag, so that there will be a space left for slits in the hem to run the cord.[1] The seams will doubtless have to be finished outside of the class hour and should be assigned for completion before the next lesson.

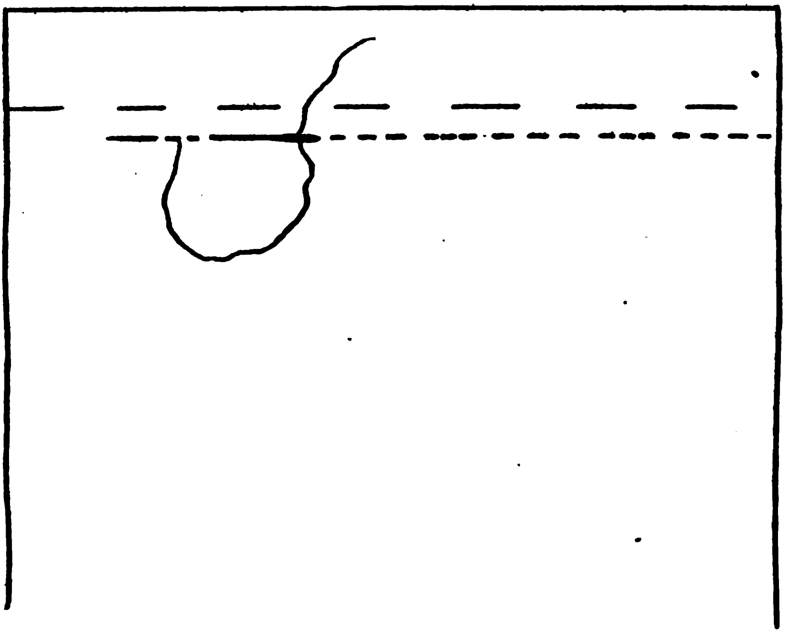

FIG. 6.—Running stitch with a back stitch.

LESSON VI. BAGS (Continued).

Overcasting the seams and turning the hem at the top of the bag.

SUBJECT MATTER.

Overcasting is done by taking loose stitches over the raw edge of the cloth to keep it from raveling or fraying.

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[1] The draw string or cord is to be run through the hem from the inside of the bag and it will be necessary to leave three-fourths of an inch of space at the ends of the seams to provide slits for the cord outlets.

PRELIMINARY PLAN.

The teacher should be sure that all the girls are ready to report, with the sides of their bags neatly sewed up with the running stitch.

METHOD OF WORK.

The teacher should demonstrate the method of overcasting and explain its use. She should have the girls trim the edges of their seams neatly and overcast them carefully. After the seams have been overcast, she should discuss with the girls the depth of the hem that they expect to use and the method of turning and basting it. The girls should turn and baste the hems, using the cardboard measure for securing the depth of the hem. If the bags are deep enough to admit of a heading at the top, a deep hem (about 2½ inches) can be made and a running stitch put in one-half inch (or more) above the edge of the hem to provide a casing or space for the cord. If it is necessary to take a narrow hem, the hem itself can be made to answer as space for the cord; in this case the hem should be made about one-half inch deep.

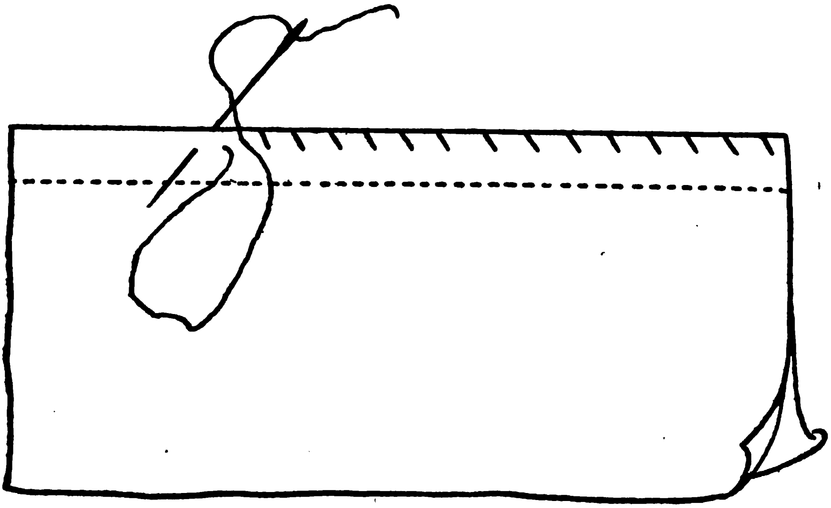

FIG. 7.—Overcasting.

LESSON VII. BAGS (Continued).

Hemming the top of the bag, putting in running stitch to provide a space for the cord.

SUBJECT MATTER.

Review of hemming stitch and running stitch.

PRELIMINARY PLAN.

The girls should report to the class with the hems basted.

METHOD OF WORK.

The teacher should review briefly with the girls the method of making the hemming stitch and the running stitch, asking them to describe these stitches and to demonstrate them on the large square of canvas before the class. The basted hems should then be sewed down with the hemming stitch.

After the hem is finished the girls should run a basting thread around the bag to mark the location of the running stitch that is to be half an inch above the hem. They should measure for this carefully with the cardboard rule.

If there is not time to do all the hemming in the class period, the hemming stitch and the running stitch (that is to provide space for the draw string) should be assigned for outside work, and each girl should bring in her finished hem at a designated time before the next class period.

LESSON VIII. BAGS (Continued).

Preparing a cord or other draw string for the bag. Putting in a double draw string in the bag so that it can easily be drawn up. Use of the bodkin.

SUBJECT MATTER.

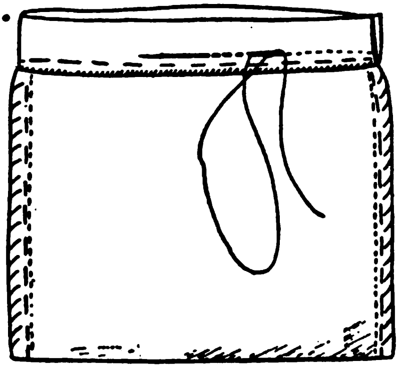

FIG. 8.—Bag nearly completed.
From Junior Circular No. 26, Agricultural Extension Department, Ames, Iowa.

To make a cord, it is necessary to take more than four times as much cotton as the final length of the cord will require, for some of the length will be taken up in the twisting of the cord. The cord should be doubled, the two lengths twisted together firmly, and the ends brought together again and held in one hand while the center is taken in the other hand, and the lengths are allowed to twist firmly together. The ends should be tied. It will be easier for two to work together in making a cord. The cord should be run into the bag with a bodkin or tape needle. If one cord is run in from one side, and another is run in from the other side, each cord running all the way around, the bag can be drawn up easily.

PRELIMINARY PLAN.

If the children are not able to supply cords for their own bags, the teacher should have a sufficient supply of cord on hand. She should be sure the girls' bags are in readiness for the cord before the class period.

METHOD OF WORK.

The teacher should begin the lesson by describing the method of making the cord, estimating the amount necessary, and demonstrating the process with the assistance of one of the girls. The girls should be numbered so that they can work in groups of two. After they have completed the cord, and run it into the bag, methods of finishing the ends neatly should be suggested to them.

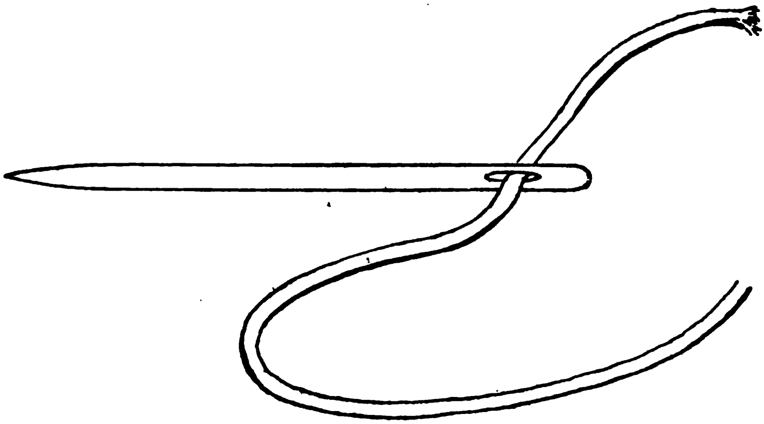

FIG. 9.—Bodkin.

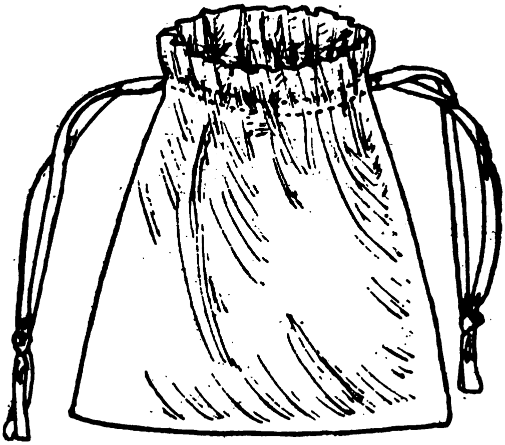

FIG. 10.—Completed bag.
From Junior Circular No. 26, Agricultural Extension Department, Ames, Iowa.

LESSON IX. DARNING STOCKINGS.

Use of darning ball or gourd as a substitute for ball. Talk on care of the feet and care of the stockings.

SUBJECT MATTER.

This lesson will involve running and weaving. Darning is used to fill in a hole with thread so as to supply the part that has been destroyed or to strengthen a place which shows signs of weakness. A darning ball, gourd, or a firm piece of cardboard should be placed under the hole. The darn should extend one-quarter of an inch beyond the edge of the material, beginning with fine stitches in the material, making rows of stitching close together in one direction, then crossing these threads with rows that run at an angle to them. Care should be taken to alternately pick up and drop the edge of the material about the hole so that no raw edges will be left and to weave evenly in and out of the material and of the cross threads.

PRELIMINARY PLAN.

Each girl should provide a pair of stockings with a few small holes and a gourd or ball of some sort that she can use for a darning ball.

METHOD OF WORK.

When the class meets the teacher should discuss briefly the care of the feet, and of stockings, and demonstrate the method of darning on a large piece of coarse material with heavy yarn and a needle. If the girls finish one darn during the lesson period, the making of another darn for practice outside of class should be assigned.

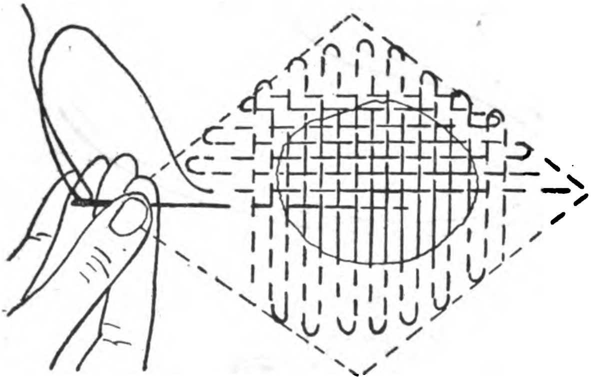

FIG. 11.—Darning.
From Junior Circular No. 26, Agricultural Extension Department, Ames, Iowa.

LESSON X. PATCHING.[1]

Hemmed patches on cotton garments. Talk on care of clothes.

SUBJECT MATTER.

This lesson will involve measuring, trimming, basting, and hemming. A patch is a piece of cloth sewed on to a garment to restore the worn part. The material used for the patch should be as nearly like the original fabric in color and quality as possible. In placing the patch, the condition of the material about the hole must be taken into consideration, as well as the size of the hole itself. The hole should be trimmed to remove worn parts near it. The patch should be 2 inches larger than the trimmed hole. The corners of the hole should be cut back diagonally, so that the edges may be turned under. The patch should be matched and pinned onto the large piece, leaving the edges of the patch to project evenly on all four sides. The edges of the material about the hole should be turned in and basted to the patch. The edges of the patch should be turned in so that they extend one-half inch from the edge of the hole when finished. The patch and the cloth should be basted together and hemmed.

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[1] Used when special problem comes up.

PRELIMINARY PLAN.

The lesson on patching should be given at any time in the course when it can be applied to an immediate need. If a girl snags her dress while playing at school or if she wears a torn apron, the teacher can announce a patching lesson for the next sewing class, and request each girl to bring a torn garment and the material for the patch from home. It may be desirable to use two or three periods for this lesson.

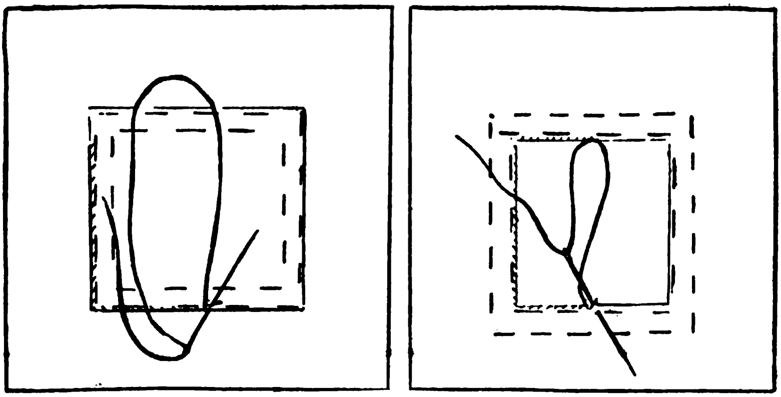

FIG. 12.—Patching.

From Junior Circular No. 26, Agricultural Extension Department, Ames, Iowa.

METHOD OF WORK.

The teacher should demonstrate the various processes of patching on a large piece of muslin. The girls should practice placing a patch on a piece of paper with a hole in it Each process should be assigned in succession—examination of article, to determine its condition; calculation of size and preparation of patch; placing the patch; trimming the article about the hole; basting the patch and material together; and hemming the patch.

LESSON XI. CUTTING OUT APRONS OR UNDERGARMENTS.

SUBJECT MATTER.

When cutting out an apron, the length of the skirt should first be measured, and to this measure 6 inches should be added for hem and seams. One length of the material corresponding to this length should be cut. This should be folded through the center lengthwise. Three-fourths of an inch should be measured down on this fold, and the material cut from the end of the selvage to this point in order to slope the front of the apron. When the waist measure is taken, 2 inches should be added to it (1 for the lap and 1 for finishing). Two pieces this length, and 2½ inches wide, should be cut lengthwise of the material for the belt. A measure should be made from the middle of the back of the waist line, over the shoulder, to a point 5 inches to the right to the center front and on the waist line. Two pieces the length of this measure, and 4½ inches wide, should be cut lengthwise of the material for the shoulder straps. A piece 9 by 12 inches should be cut for the bib, the longer distance lengthwise of the material. These measurements allow one-quarter inch for seams.

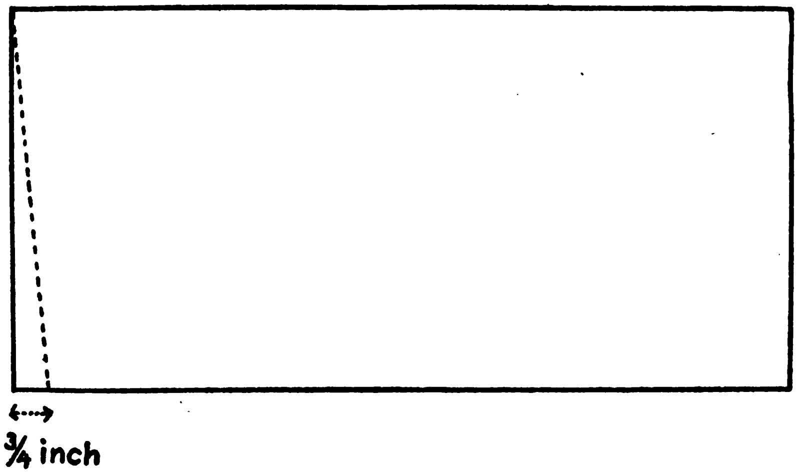

FIG. 13.—Cutting out skirt of apron.

PRELIMINARY PLAN.

Previous to the lesson the teacher should see if arrangements can be made to secure the use of one or two sewing machines, so that the girls can sew all the long seams of their aprons by machine.

At a previous lesson she should discuss with the girls the material of which they can make their aprons. They should consider whether the apron should be white or colored, and whether it should be of muslin, cambric, or gingham. Each girl will need from 1½ to 2 yards of material, according to her size. The taller girls will need 2 yards.

There should be on hand a sufficient number of tape measures, pins, and scissors, so that the girls can proceed with the cutting of their aprons with no unnecessary delay.

The apron to be made is to have skirt, bib, and shoulder straps, in order to be a protection to both dress, skirt, and waist.[1]

METHOD OF WORK.

As soon as the class meets, the girls should make the measurements for their aprons. One measurement should be assigned at a time and the reason for each measurement given. The girls should follow the measurements explicitly, as they are apt to become confused if directions are complicated. They should work carefully so that the material does not become mussed or soiled, and at the conclusion of the lesson they should fold it carefully and put it away neatly. All threads and scraps of material should be carefully picked up off the floor, and the room left in order.

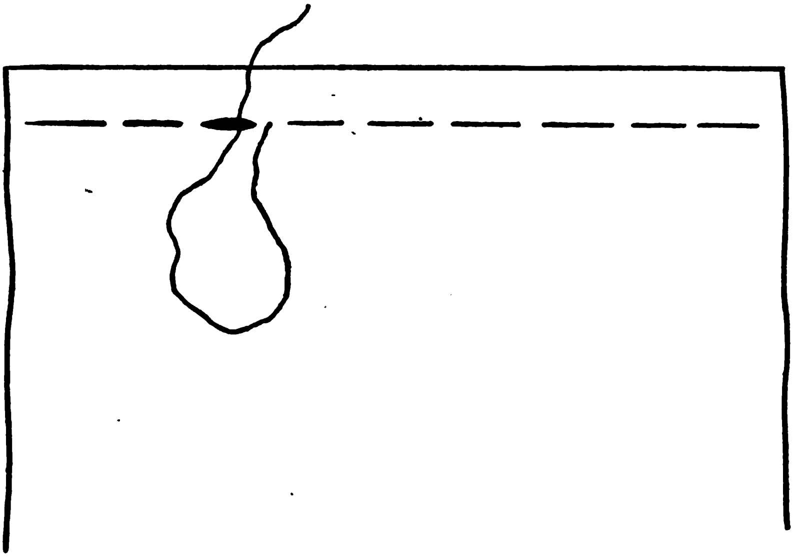

FIG. 14.—Uneven basting.

LESSON XII. APRONS OR UNDERGARMENTS (Continued).

Basting the hem for hemming on the machine or by hand. Uneven basting.

SUBJECT MATTER.

An uneven basting forms the better guide for stitching. In uneven basting the stitches are made about twice as long as the spaces between. The stitch should be about one-fourth of an inch on the upper side of the material and one-eighth inch on the under side.

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[1] If the girls are very inexperienced and find the sewing difficult, it may be advisable to omit the bib and straps and to make the simple full-skirted apron. If a machine is not at hand to use for the long seams, the limits in time may make the simpler apron necessary. This will give more time for the various processes. Lessons XIV and XV can then be omitted, Lesson XVI made simpler, and less outside work required.

PRELIMINARY PLAN.

In addition to the apron material which has been cut out in the previous lesson, each girl should provide her own spool of thread (number "Sixty" white thread will probably answer for all the work), a piece of cardboard 5 inches wide to use for marker, and pins to use in fastening the hem.

METHOD OF WORK.

As soon as the class meets, the girls should prepare a 5-inch measure of cardboard to guide them in turning the hems of the skirts of their aprons. They should make a half-inch notch in the measure for the first turn in the material. A one-half inch edge should be turned up from the bottom of the skirt, then a 5-inch hem turned, pinned, and basted carefully with uneven basting. The card board marker should be used for both measurements.

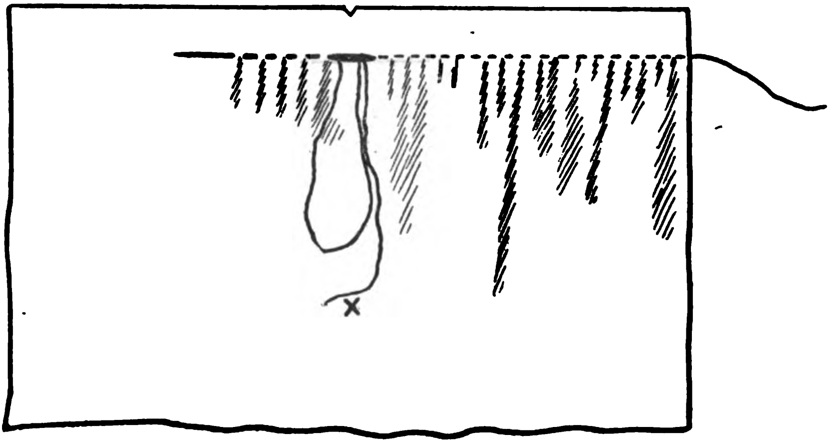

FIG. 15.—Gathering.

LESSON XIII. APRONS OR UNDERGARMENTS (Continued).

Gathering the skirt and stitching to the belt.

SUBJECT MATTER.

In gathering, the running stitch is employed. Small stitches are taken up on the needle with spaces twice as great between them. The top of the skirt should be divided into halves, and gathered with two long double threads, using fine stitches and placing them one-quarter inch from the edge. The center of the belt and the center of the top of the skirt of the apron should be determined upon. The belt should be pinned to the wrong side of the apron at these points, and the fullness drawn up to fit (approximately one-half of the waist measure). The skirt and belt should be pinned, basted, and sewed together.

PRELIMINARY PLAN.

If the hems have been completed in the skirts, the girls are ready to gather the skirts and attach them to the belt. It will be well to have pins on hand to use in fastening the skirt and belt together.

METHOD OF WORK.

The teacher should first demonstrate the method of gathering and assign that portion of the lesson. When the skirts have all been gathered she should show the girls how to measure, pin, and baste the skirt to the belt.

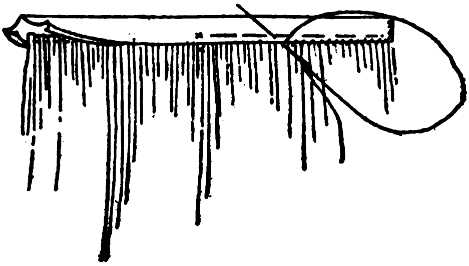

FIG. 16.—Sewing on the belt of the apron.
From Junior Circular No. 26, Agricultural Extension Department, Ames, Iowa.

LESSON XIV. APRONS OR UNDERGARMENTS (Continued).

Making the bib.

SUBJECT MATTER.

A 2-inch hem should be turned across one short end of the bib. This should be basted and hemmed. The bottom of the bib should be gathered, using the method employed for the top of the skirt, and leaving enough thread to adjust the gathers easily.

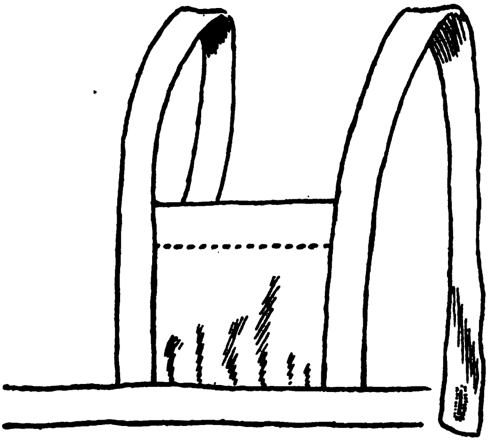

FIG. 17.—Bib and straps of apron.

PRELIMINARY PLAN.

If the girls have completed the skirts and attached them to the belts, they are ready to make the bibs. They should be provided with a 2-inch marker for use in making the hems in the top of the bibs.

METHOD OF WORK.

The teacher should guide the girls carefully in the making of the bibs, reviewing their knowledge of basting, hemming, and gathering.

LESSON XV. APRONS OR UNDERGARMENTS (Continued).

Making the straps.

SUBJECT MATTER.

One end of one of the straps should be placed at the bottom of the bib. The side of the strap should be pinned, basted, and sewed to the right side of the bib with a running stitch. The other long side of the strap should then be turned in one-quarter of an inch and the ends turned in one-half of an inch. The strap should then be folded through the center for its entire length and the free side basted to the wrong side of the bib and hemmed down. The remaining edges of the strap should be overhanded together. The other strap should be sewed to the other side of the bib in the same way.

PRELIMINARY PLAN.

The bibs should have been completed before the girls report for this lesson.

METHOD OF WORK.

As soon as the girls report for the lesson, the teacher should explain the method of attaching the straps to the bib and tell them how to finish the straps. As they proceed with their work, she should supervise them carefully and assign the unfinished portion of the work for completion outside of the class.

LESSON XVI. APRONS OR UNDERGARMENTS (Continued).

Putting the bib and skirt on the belt.

SUBJECT MATTER.

The center of the bottom of the bib should be determined, and pinned to the upper edge of the belt, to which the skirt has already been attached. The belt should be fastened to the wrong side of the bib. The gathering string of the bib should be drawn up, leaving 2 inches of fullness on each side of the center. The bib should be pinned, basted, and sewed to the belt. The remaining long edges of the belt should be turned in one-fourth inch, and the ends one-half inch. The edges of the other belt piece should be turned in the same way, and should be pinned over the belt to which the skirt and bib have been attached (with all the edges turned in), and basted carefully to keep the edges even. The skirt and bib should be hemmed to this upper belt, and all the remaining edges should be overhanded.

PRELIMINARY PLAN.

The bib and straps of the apron should be completed before the girls report for this lesson.

METHOD OF WORK.

The teacher should guide the girls carefully in the various steps necessary in fastening the bib to the belt and in completing the belt. If the hemming and overhanding is not completed during the class hour, they can be assigned for outside work.

LESSON XVII. METHODS OF FASTENING GARMENTS.

Sewing buttons on the aprons, petticoat, or other garment.

SUBJECT MATTER.

This lesson should teach neatness in dress through a consideration of the best methods of fastening garments. The position of the button is measured by drawing the right end of the band one inch over the left end. The location of the button should be marked with a pin on the left end of the band. A double thread is fastened on the right side of the band, drawn through one hole of the button, and back through the other, taking it through the band close to the first stitch. A pin should be inserted on top of the button under the first stitch, and left there until the button is firmly fastened in place; then removed. Before fastening the thread, it should be wrapped two or three times around the threads holding the button, between the button and the cloth, then fastened neatly on the wrong side with a few small stitches one on top of the other.

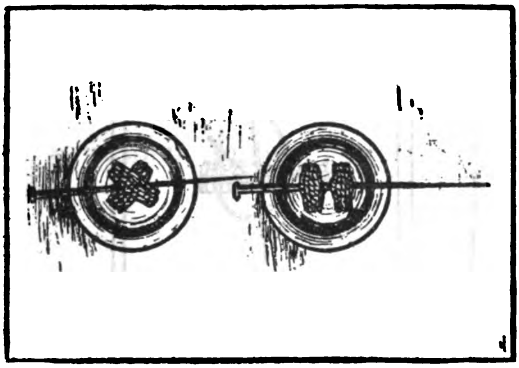

FIG. 18.—Sewing on buttons.
From Junior Circular No. 35, Agricultural Extension Department, Ames, Iowa.

PRELIMINARY PLAN.

Each girl should come to the class with her apron as nearly completed as possible, and with three buttons to sew on it for fastening the belt and straps.

METHOD OF WORK.

The teacher should discuss the best methods of fastening garments with the girls, and she should demonstrate the method of sewing on buttons. The girls should sew one button on the left end of the apron band in the middle of the width about 1 inch from the end and another button 4 inches from each end of the band to hold the shoulder straps.

LESSON XVIII. METHOD OF FASTENING GARMENTS (Continued.)

Buttonholes on practice piece, and on apron.

SUBJECT MATTER.

Directions for making the buttonhole.—Measure the location of the buttonhole carefully lengthwise of the band, so that the end will come one-fourth inch from the edge of the garment. Mark the length of the buttonhole on the material by putting in two lines of running stitches at the ends. To cut the buttonhole, insert the point of scissors at the point marked by the running stitches nearest the edge of the garment and cut carefully along the thread of the material to the row of stitches marking the length at the other end.

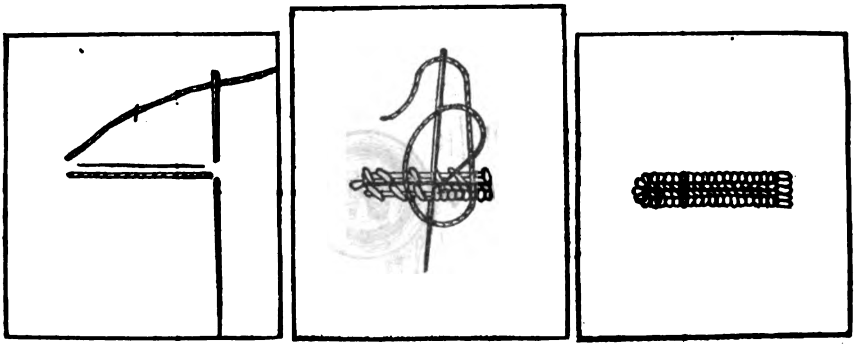
(a) Starting the button hole.
(b) The buttonhole stitch.
(c) The finished button hole.

FIG. 19.—Working buttonholes.

From Junior Circular No. 35, Agricultural Extension Department, Ames, Iowa.

To make the buttonhole, use a thread of sufficient length to do both the overcasting and the buttonholing. Beginning at the lower right corner, overcast the raw edges with stitches one-sixteenth of an inch deep. Do not overcast around the ends of the hole. As soon as the overcasting is done, go right on with the buttonholing without breaking the thread. Hold the buttonhole horizontally over the first finger of the left hand and work from right to left. Insert the point of the needle through the buttonhole (at the back end), bringing the point through toward you four or five threads below the edge of the buttonhole. Bring the doubled thread from the eye of the needle from right to left under and around the point of the needle, draw the needle through, forming a purling stitch. At the end of the buttonhole make a fan by placing from five to seven stitches. The thread should be fastened carefully on the under side of the buttonhole

PRELIMINARY PLAN.

For this lesson it will be desirable to have small pieces of muslin on hand to use as practice pieces for the buttonholes.

METHOD OF WORK.

The teacher should demonstrate the making of a buttonhole, illustrating each process on a large piece of canvas. The girls should sew two small strips of muslin together and cut a buttonhole one-fourth inch from the edge of the material, and lengthwise of the material, to work for practice. When the buttonhole has been sufficiently perfected on the practice piece, the girls should make a buttonhole on the band of the apron. The buttonhole should be made in the right end of the band, and in each end of each shoulder strap.

LESSON XIX. A PADDED HOLDER FOR HANDLING HOT DISHES. BINDING.

SUBJECT MATTER.

A holder 6 inches square will be satisfactory for handling hot dishes. It can be made of quilted padding bound with tape or of two thicknesses of outing flannel covered with percale or denim, and bound with tape or braid. If made of the outing flannel and covered, it should be quilted by stitching from the middle of one side to the middle of the opposite side in both directions in order to hold the outing flannel and the outside covering together. The tape that is to be used for the binding should be folded through the center lengthwise, then beginning at one corner of the padding the edge should be basted, half on one side and half on the other. Right-angled corners should be formed. When basted all around, the tape should be sewed down on each side with a hemming stitch.

If the holder is to be suspended from the apron band, a tape of from 27 inches to 36 inches in length should be attached to one corner. The raw edge at one end of the tape should be turned in. The end should be so placed that it overlaps the corner of the holder about one-half inch and should be basted to the holder. The tape should then be secured firmly to the holder, hemmed down one edge across the bottom, and up the other edge. The other end of the tape should be finished with a 2-inch loop. The raw edge should be folded over, the tape turned 2 inches down for the loop, and basted in place. This should be hemmed across the end. One-fourth inch up from the end the double thickness of tape should be back-stitched together and the edges of the tape overhanded from there to the hemmed end.

PRELIMINARY PLAN.

Each girl should provide sufficient denim, percale, muslin, or other easily washable material to cover the two sides of a holder 7 inches square and enough outing flannel or canton flannel for a double lining. About 1½ yards of straight tape one-half inch wide will be needed for the binding and to suspend the holder from the apron.

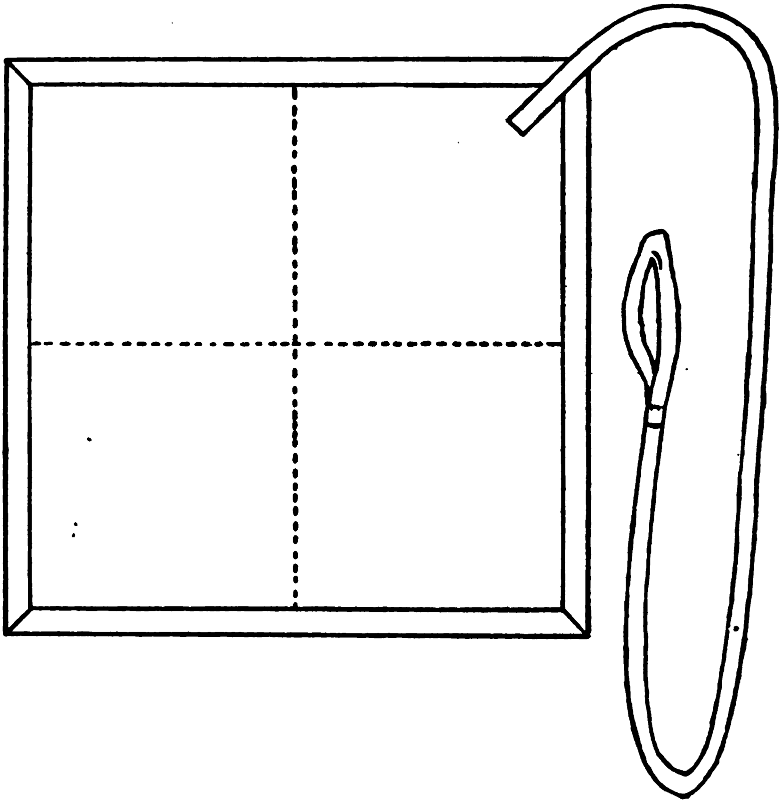

FIG. 20.—The holder.

METHOD OF WORK.

The girls should first carefully measure and turn the material for the covering of the holder and then prepare the lining, basting it all together, then putting in the running stitch and finishing with the binding.

If it is not possible to complete the holder in one period, a second lesson period should be provided, or arrangements made to have supervised work done out of lesson hours.

LESSON XX. A CAP TO WEAR WITH THE COOKING APRON.

SUBJECT MATTER.

The simplest cap to make will be the circular cap. A pattern should be made by drawing a circle 21 inches in diameter with a pencil and string on a piece of wrapping paper. The material for the cap should be cut carefully around the circle and finished with a narrow hem. A tape to hold the draw string should be placed 1¼ inches inside the edge of the hem. A small piece of cardboard cut about one-half inch wide should be used for measuring the location of the tape. Bias strips three-fourths inch wide can be prepared for the tape, or a commercial tape three-eighths inch wide can be purchased. The outer edge of the tape should be basted down first, the edges joined, then the inner edges should be basted, keeping the edge smooth. Both edges should be neatly sewed down with hemming stitch by hand or on machine. An elastic should be inserted in the band, carefully fitted to the head, and ends fastened neatly.

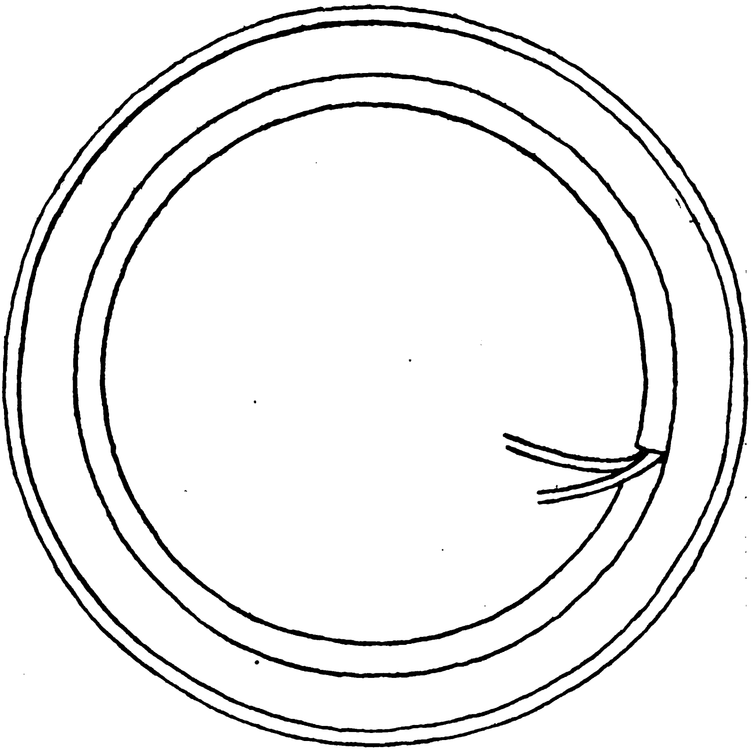

FIG. 21.—Cap.

PRELIMINARY PLAN.

This lesson will give good opportunity to make a cap that will answer for a dust cap or serve as a part of the cooking uniform. If such a cap does not seem desirable and the former lesson has not been completed, the cap can be omitted and the work on the holder continued.

METHOD OF WORK.

The girls should first make the pattern for the cap and then cut out their material. The hem should be basted and stitched with the hemming stitch. The bias strip should be basted on and sewed down with the running stitch. It will probably not be possible for the girls to complete the cap in one class period, but if the material has been cut out and the work started, they may be able to complete it at some other time. The stitches are not new and the work will serve as an excellent test of the skill they have acquired in the course.

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DEPARTMENT OF THE INTERIOR
BUREAU OF EDUCATION

BULLETIN, 1917, No. 24

MONTHLY RECORD OF CURRENT EDUCATIONAL PUBLICATIONS

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FEBRUARY, 1916–JANUARY, 1917

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LETTER OF TRANSMITTAL.

Department of the Interior,
Bureau of Education,
Washington, April 17, 1917.

Sir: To meet the demand for information as to what provision is made in the several countries of the world for military teaching for boys of school age, I have caused to be prepared the manuscript which is transmitted herewith and which I recommend for publication as a bulletin of the Bureau of Education.

Respectfully submitted.

P. P. Claxton,
Commissioner.

The Secretary of the Interior.

MILITARY TRAINING OF YOUTHS OF SCHOOL AGE IN FOREIGN COUNTRIES.

INTRODUCTION.

The matter presented in this circular relates to the military training of youths of school age, conducted either as a part of the regular school work or by independent agencies. Military instruction, of the exact nature and to the same extent as that given to soldiers, is not found in the schools of any country of Europe except the special military schools. Such training is confined everywhere to the period of active service, and no attempt has ever been made to impose upon the school the task of producing fully trained soldiers. In many countries having universal military service the public schools provide for training boys in such elements of military science as may be conveniently combined with their physical training and at the same time prepare them for the active service awaiting every young man.

The attitude of foreign educators in the matter is well defined. They do not, as a rule, regard the military instruction as a successful substitute for the well-established systems of physical training and character building. They generally view it as an anomaly in the school system, justified only by the exigencies of national defense. The enthusiastic support they lend this work comes more from patriotic than from pedagogic motives. Occasionally, however, the beneficial effects of military training upon the moral and physical sides of boys' education are emphasized. Very marked results of this nature have been observed in Australia, which should have more than passing attention.

In France, where military training is a component part of the prescribed program of public primary schools, it is not approved by leading educators as a method of physical training, but it is recognized and commended as preparatory training for military service, intended to raise the efficiency of the French Army. The programs of public schools of France include gymnastics and moral instruction, the former as a means of building up the physique of the boys and the latter of developing their character; it is generally recognized that these two objects of education can not be perfectly attained by any system of military training.

On this subject one authority says:[1]

> Military training may present, as regards hygiene, serious inconveniences; it implies rigid discipline, which is condemned by true pedagogy. Outside of that it produces results that are only partial, limited, and special.

This opinion relates to military training regarded as a method of physical education. But by the same authority military instruction is termed "a work of urgent interest to the country and to all young citizens."

These quotations represent fairly the attitude of enlightened and patriotic French opinion.

An Austrian educator, Prof. E. Bausenwein, writes on the same subject as follows:[2]

> Shooting practice in the Austrian secondary schools was not introduced as a matter of sport to which one may be devoted or not but as a serious necessity, the effects of which are rightly estimated as of great importance for the defense of the State in a time of trial.

Although each country possesses its own system of military training of school youths, adapted to the specific conditions and purposes of the movement in each particular instance, a certain similarity of origin and organization of these movements may be observed. In most cases the source of the movement can be traced to the department of war, assisted by the department of education and patriotic organizations of citizens. Where military instruction is not an obligatory part of the public school curricula, it is promoted in the form of student organizations under the leadership of patriotic clubs and aided by Government grants and by the lease of Government property. In those countries where the Governments are not directly active in this work it often arises spontaneously under the guise of semimilitary clubs.

It is also a significant feature of all militaristic movements affecting the schools that they appear wherever and whenever special need is felt for raising the standard of the military preparedness of the nation. In France the movement was started after the disastrous war of 1870 and revived after the reduction of the term of active service in 1905. In Austria intensive military work in schools was launched after a similar reduction of the term of service. In Switzerland and Australia it accompanied the introduction of an abbreviated system of universal military service. During the period from 1908 to 1914, when apprehension of the oncoming European conflict was keen among the nations of the Continent, the training of school youths in warlike exercises was greatly extended. In Germany, according to Körperliche Erziehung, schoolboys were attracted in this period to numerous civilian rifle clubs and semimilitary organizations.

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[1] L'Annuaire de la Jeunesse, 1914, p. 4.

[2] Körperliche Erziehung, June, 1912.

In a certain sense all work of a military nature performed by schoolboys, whether compulsory or voluntary, whether promoted by the State or by private agencies, and whether in the nature of extensive military training or of simple close order drill, is worthy of note in the present consideration. The differences that appear between the countries here treated are chiefly those of degree of universality and thoroughness of the training given. Australia and Switzerland have the best organized systems of preparatory military training; in both these countries this work is regarded as a part of the regular military training provided for the Army, the school simply relieving the military establishment of a part of its task and shortening thereby the term of training in the active service. In other countries, like Great Britain, the work appears in an unorganized, sporadic, and limited form, or in conjunction with training for other purposes. Between the two extremes represented by Switzerland and England there are several intermediate forms, such as (*a*) prescribed military drill, but in a limited extent, or (*b*) thorough military training, but conducted by outside agencies and therefore not obligatory, or (*c*) prescribed military training limited to certain kinds of schools, etc.

For a comparative view, a bare outline of the systems prevailing in various countries is given below. It will be seen that the list includes all the important countries for which information is at present available. This outline is followed by detailed statements for the several countries and a bibliography.

BRITISH EMPIRE.

England.—Strictly voluntary work carried on by private agencies.

Australia.—Military instruction compulsory for all boys from 12 to 18 years of age.

New Zealand.—Military instruction compulsory for boys over 14 years.

Canada.—Military instruction carried on in voluntary cadet corps.

FRANCE.

Prescribed military instruction without arms, and rifle practice in elementary and higher elementary schools. Ages 9 to 13 years; rifle practice limited to boys over 10 years of age. Specially trained instructors. Strong organizations carry on the work of military preparation among older boys.

GERMANY.

Voluntary organizations of older public-school pupils and students of secondary schools. Training *without arms*. Decrees issued during the war provide for preparatory military training of all boys over 16 years of age.

AUSTRIA-HUNGARY.

Austria.—Voluntary organizations for military training of pupils of secondary schools, under Government protectorate. Optional rifle practice in the last two years of secondary schools.

Hungary.—Military training obligatory in the last three years of certain gymnasia designated by the Government. Voluntary rifle clubs in secondary schools. Military drill in primary schools.

SWITZERLAND.

Instruction in military gymnastics in elementary schools obligatory throughout the school age. Conducted by specially trained instructors. Voluntary rifle practice and military drill both with and without arms.

SWEDEN.

Compulsory rifle practice in public secondary schools for boys from 15 to 18 years of age. Given by special instructors.

NORWAY.

Voluntary rifle practice.

ITALY.

Military training given as obligatory subject in "national colleges." Private agencies provide for simple military drill for younger boys.

SPAIN.

No distinct military training is given. Some simple drill is included in the program of physical training.

PORTUGAL.

No military training is given in schools. The subject of "physical culture," which is taught generally, includes simple drill without arms. Boy Scout organizations are numerous.

RUSSIA.

Prescribed military gymnastics in elementary and secondary schools.

NETHERLANDS.

Military training given in voluntary organizations for boys over 15 years of age.

GREECE.

Very intensive military instruction is given in gymnasia, under the patronage of the King. Simple drill obtains in all public schools in connection with physical training.

JAPAN.

Military gymnastics obligatory in elementary, secondary, and normal schools.

MEXICO.

Obligatory military drill with arms in all primary and secondary schools. Regulated by State laws.

ARGENTINA.

Obligatory military training in the last two years of secondary schools. Specially trained instructors.

BOLIVIA.

Simple drill in connection with gymnastics.

BRITISH EMPIRE.

ENGLAND.

All the training of schoolboys in England of a military or semimilitary character is conducted by outside agencies. The only attempt to introduce this training into the regular work of the schools was made in 1906, the date of Haldane's Territorial Forces Act. The bill included a provision for compulsory military drill in schools, but owing to determined opposition, both in Parliament and in the country, this provision of the bill was rejected.

The voluntary organizations enroll only a small proportion of the youths of England, but in a certain sense their importance is incommensurate with mere numbers. This is especially true in reference to the cadet corps, which have been in existence for over 55 years and have become part of the educational system of the country in almost the same degree as cricket and football teams. It was observed that a surprisingly large number of young men enlisted in Kitchener's army had previous military drill in cadet corps, which proved of great advantage in their hurried preparation for active service.

The organization of English cadet corps is well known; these bodies still continue to be a model for similar organizations in the United States. The cadet corps were first founded in 1860 and in the course of a few years spread rapidly throughout the country. A revival of the movement occurred in 1906, directly following the defeat of the provision for compulsory military training in schools, mentioned above. This revival was especially noticeable in secondary schools, where many new battalions were formed.

The European war stimulated a new interest in the matter. The question of compulsory military training in schools was again raised, and various suggestions were advanced as to the most expedient methods of organizing this work. No decisive steps, however, have been taken thus far.

In recent discussions of the subject the trend of opinion seems to be against cadet corps and in favor of organizations that entail less expense and, at the same time, are capable of attracting larger numbers of pupils. It is pointed out that the cost of uniforms, the difficulties connected with the selection of a proper kind of rifles, the want of officers, and other conditions prevailing in the cadet-corps system tend to limit membership in the corps to an exclusive group of students. To overcome these difficulties nonuniformed corps have been organized. The boys drill with wooden dummy rifles under the command of teachers. For target practice small-caliber rifles are used. Infantry drill is conducted in accordance with the latest army regulations. The chief advantage of this system lies in the fact that *all* pupils of a given school participate in the work of the corps, and the drills form a part of the ordinary school program.

The first nonuniformed corps was established in 1881 at the Hackney Downs school and has been conducted with considerable success down to the present time.

Junior divisions of officers' training corps are organized in many schools. These courses correspond to similar courses of reserve officers' training corps in the United States. They have proved very useful during the war.

Among organizations not avowedly military, but devoted to exercises of a military or semimilitary character, the most popular in England are boys' brigades, church-lads' brigades, and boy scouts.

Boys' brigades were founded originally in Glasgow, in 1883, by W. A. Smith. The object of the brigades is to develop in the young generation a Christian manliness by means of physical training and discipline. The brigades exercise in military movements and gymnastics, participate in summer camps, and attend religious services and classes. The movement gradually spread to the English colonies and the United States; at present the estimated number of boys in the brigades in the English-speaking countries is over 100,000.

Church-lads' brigades are similar organizations confined to the Anglican communion.

The boy-scout movement, originated in 1908 by Maj. Gen. Baden-Powell, has been adopted by almost every civilized nation. Although the movement is nonmilitary, it is generally admitted that the qualities of character and mind developed in the boys by the scout system are those highly valued in military service and indispensable in at least one branch of that service, namely, scouting and patrolling.

AUSTRALIA.

The "Defense Acts" adopted in succession during the period from 1903 to 1914 form the basis of the military organization of the Commonwealth. The military instruction given in schools is part of the system of national defense and as such is fully provided for and regulated by the acts.

By the latest measures all male inhabitants of Australia who are British subjects and have resided in the Commonwealth for six months must serve in the citizen's army. The compulsion extends over the entire period of training, which is divided into three cycles as follows:

(*a*) From 12 to 14 years of age, in the junior cadets.
(*b*) From 14 to 18 years of age, in the senior cadets.
(*c*) From 18 to 26 years of age, in the citizen force.

Junior cadets.—Junior cadet training, lasting for two years, consists of 90 hours each year, and begins on the 1st of July in the year in which the boy reaches the age of 12 years. This period of training aims at developing the cadet's physique. It consists principally of physical training for at least 15 minutes each school day and elementary marching drill. The following subjects are also taught: Miniature rifle shooting; swimming; running exercises in organized games; first aid; and (in schools in naval training areas) mariners' compass and elementary signaling. The junior cadets are not organized as military bodies and do not wear uniform. The Commonwealth Government maintains a staff of special instructors of physical training, by whom classes are held for school-teachers in all districts of the Commonwealth in order to increase the science and proficiency of the latter in the military subjects they are to teach in their schools. The inspectors of schools supervise the training and inspect the cadets on behalf of the defense department.

Senior cadets.—Senior cadet training lasting for four years begins on the 1st of July of the year in which the boy reaches the age of 14 years. On entering this part of the course each cadet must present himself for registration and show that he has completed the necessary training in his thirteenth and fourteenth years. The senior cadet course consists of 40 drills each year, of which 4 are classed as whole days of not less than four hours, 12 as half days of not less than two hours, the remainder being night drills of not less than one hour. This allotment of time may be modified to meet special conditions, but the minimum efficient service required of senior cadets is invariably 64 hours per annum. Registration of every male born in 1894 and subsequently, and who has resided for six months in the Commonwealth, must be effected in the first two months of the calendar year in which he completes his fourteenth year.

The four years' work covers the foundation necessary for any arm of the service. It comprises marching, handling of arms, musketry, physical drill, first aid, guards and sentries, tactical training as a company in elementary field work, and elementary battalion drill. Discipline is strongly inculcated.

On the 1st of July of the year in which he completes his eighteenth year the cadet enters the period of adult service and is assigned to the arm of the service in accordance with his preference or special qualifications.

Enforcement of the compulsion.—The training, both in junior and senior cadets, is compulsory for all boys except aliens and non-Europeans. Theological students are exempt from training. In some sparsely populated districts the compulsion is not applied as rigidly as in other districts because of undue hardships that it would impose.

Employers, parents, and guardians may not, under a heavy penalty, prevent any employee, son, or ward who is in training from rendering service; penalties are also imposed upon cadets evading service. Penalties take the form of money fines or detention in military custody under enforced training and discipline. Evasion is also punished by ineligibility for any employment in the public service of the Commonwealth. Children's courts are used where possible for the prosecution of cadets under the age of 16 years.

While in training senior cadets and soldiers are required to satisfy certain requirements of efficiency and are tested every year. Those failing to pass in the annual test must do an extra year's training. Each senior cadet must pass four annual tests of efficiency.

Instructors.—Both cadets and enlisted men are trained by a military instructional staff consisting of Army officers and noncommissioned and warrant officers. This staff was organized immediately after the enactment of the law, and the officers and noncommissioned officers selected as instructors were put through a short course of special training.

Operation of the system.—A slight amount of opposition has been manifested to the system. This, however, was principally for personal or religious considerations. It is claimed that the scheme, both before its inception and since its successful inauguration, has had the support of leading statesmen of all political views, as well as the vast majority of the citizens of the Commonwealth. Much interest and willingness is shown on the part of the youths in training, which is evidenced by a great amount of voluntary work done, such as athletic, gymnastic, target practice, etc. A marked improvement has quite lately become apparent in the general conduct and bearing of the youths of Australia, and it is claimed that this is the effect of the system of universal training. As a result of inquiries made in 1914, the police authorities in all the States concurred in the opinion that the behavior of the youths who are subject to the training is vastly improved. It is stated that, both mentally and morally as well as physically, the benefits are very definite, and that the principal effects of a beneficial nature are increased self-respect, diminution of juvenile cigarette smoking, and "larrikinism," and generally a tendency toward a sense of responsibility and a desire to become good citizens.

In regard to opposition to the system, the percentage of prosecutions to number liable for training in 1914 was 5.38. This figure includes all classes of cadet and active service; it also includes the parents, employers, and guardians.

Statistics.—In 1914 there were 87,000 senior cadets undergoing compulsory training and nearly 50,000 junior cadets were certified for physical training. The number of citizen soldiers in training was more than 51,000.

NEW ZEALAND.

The Defense Act of 1910–11 makes military training compulsory for every male New Zealander from the age of 14 years to the age of 25 years, after which he serves in the reserves up to the age of 30.

The first period, beginning when the boy reaches the age of 14, or completes the course of a primary school, is known as senior cadet age. The training given in this period is similar to that given in Australia, and consists of a system of military drills, rifle practice, etc. Senior cadets are part of the army organization in every respect, except that they are not liable to be called to arms.

On reaching the age of 18 years, if found physically fit, a cadet is drafted into the Territorial Force.

In 1914 there were 25,300 cadets in training in New Zealand.

In various reports on the effects of the cadet system, beneficial physical and moral results are invariably emphasized. Employers and other persons concerned remark upon the improvement of the cadets in their general conduct, physique, and sense of civil obligations.

CANADA.

Military training of youth of school age in Canada, while not embodied in any obligatory system, has attained a high measure of uniform development through the combined efforts of educational and military authorities, and of the Strathcona Trust, to which is committed a fund ($500,000) given by Lord Strathcona for the promotion of physical culture, military training, and rifle practice in the schools of Canada. Local committees of the trust are established in the several Provinces, and the interest derived from the fund is distributed among them according to a fixed scheme.[1]

In the majority of the Provinces physical training is a prescribed subject in all primary schools. Since this training includes, as a rule, simple military drill, it serves as a preparation for subsequent military services. Formal military training is given in voluntary cadet corps, which are organized in accordance with the official "Regulations for the Cadet Services of Canada, 1913," and subsequent amendments.

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[1] See Rept. of Commis. of Educ., 1916, Vol. I, pp. 525–526.

The corps are classified as follows: (1) Those consisting of pupils in attendance at colleges and schools controlled by provincial government; (2) those composed of pupils in attendance at colleges and schools not under Government control; and (3) those composed of boys who, with the permission of their parents, prefer to join corps unconnected with educational establishments. The age limits for cadets are 12 to 18 years. Where a cadet corps is affiliated with an educational institution, a bona fide student who exceeds the regulation age may join the corps or continue to be a member, provided there is no militia unit affiliated with the institution which he might join. Instruction is given as far as possible by the ordinary schoolteachers, who must be fully qualified by attendance at a military school of instruction and holding a cadet instructor's certificate or its equivalent. The syllabus of instruction includes general physical training and military drill, semaphore signaling, and the use of arms (rifles and gallery-practice guns being supplied by the Government).

FRANCE.

The movement in favor of an extensive education of youth in military arts was started immediately following the war of 1870. In 1871 the minister of public instruction, Jules Simon, issued a circular to school principals advising them to devote special attention in their schools to physical training and instruction in the handling of arms. The law of January 21, 1880, made physical training, including military drill, obligatory in all public schools. The law was followed by a manual of gymnastics and military training in two volumes, edited by a special commission and issued by the ministry of public instruction. A circular issued by the minister in connection with the appearance of this textbook made an earnest appeal to school principals to give the matter of military training thorough consideration. The circular said:

> You know the purpose of this training; you know what importance we ought to attach to it. To use the expression of the honorable author of the bill on physical training, "It is not simply a matter of health, of bodily vigor, of the physical education of French youth; it is equally a matter of the successful operation of our military laws, of the composition and strength of our army."

The military training prescribed by the law consisted of drill without arms, and shooting practice; the latter, however, was not introduced at once owing to delay on the part of the authorities in providing the rifles. In July, 1881, an appropriation of 1,000,000 francs for military training in schools enabled the Government to purchase 52,600 rifles. These rifles were adapted for target practice exclusively. In many localities, however, school authorities procured rifles of the service pattern, but of lighter weight and constructed so they could not be fired; these were used for drills with arms. In Paris, and later in numerous places in the province, especially in eastern Departments, school cadet corps were organized soon after the promulgation of the new law. These organizations, called "bataillons scolaires," became very popular both with the students and the public.

In 1882 the battalions received official sanction and regulations, and military training was introduced as a distinct subject into the curricula of public schools.

The school battalions were composed of boys over 12 years of age, whose fitness for receiving military instruction had been attested by a commission consisting of two officers designated by military authorities and a school inspector. Each battalion was authorized by the local chief of police. The ministry furnished distinctive flags for the battalions that achieved satisfactory progress after the first year of existence. The instructors were designated and supplied by military authorities. Drill rifles used by the battalions were made so they could not be used for shooting. For target practice, which was limited to students over 14 years of age, small caliber rifles were used, and ammunition was distributed with the usual precautions. Uniforms were not obligatory, but most of the school battalions adopted uniforms patterned after those first introduced in Paris—short jackets, long, marine-blue trousers, and Scotch bonnets.

The life of the school battalions was short. The records of the ministry of public instruction show that the last flags were distributed in 1886, after which date the battalions were disbanded. Among the reasons given for the failure of these organizations are:[1]

> The deterioration of the spirit that animated the original promoters of this work, and the consequent meagerness of the results obtained; lack of public interest and support that became manifest as this change took place.

The idea that prompted the creation of the school battalions survived the crisis, however, and soon found expression in a more practical and more efficient form of "Union des sociétés d'instruction militaire de France," founded in 1890, which merged, in 1907, with the "Association nationale de préparation des jeunes gens au service militaire" to form the now celebrated organization "Union des sociétés de préparation militaire de France." The work of this organization is discussed below.

As regards the prescribed programs of military instruction in primary schools, the order of 1882 was replaced in 1887 by new regulations which limited the instruction to the middle and higher divisions of elementary schools, to be pursued according to the following outline:

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[1] F. Buisson: Nouveau dictionnaire de pédagogie. Paris, 1911.

> *Middle division.*—Exercises in marching, alignment, formation of squads, etc. Preparation for military service.
>
> *Higher division.*—School of the soldier without arms. Principles of the several steps. Alignments, marches, countermarches, and halts. Changing the direction.

According to latest advices (Annuaire de la Jeunesse, 1914) this program is still in effect.

In higher elementary schools the official programs comprise, in addition to gymnastics, the "preparatory military exercises" consisting in advanced drills and maneuvers.

An order of July 27, 1893, in force to date, added target practice to this program. The full text of this order is as follows:

> In the middle course and the higher course of public primary schools the following addition is made to the program of military exercises, to wit: For pupils over 10 years of age exercises in shooting at 10 meters with Flobert rifles. (The name Flobert is given to several makes of small-bore guns, mostly .22 caliber.)

Since the enactment of this order two circulars have been issued by the minister of public instruction dated, respectively, June 27, 1903, and April 26, 1907, regulating the conduct of gun practice in the schools. The latter circular is especially interesting as an evidence of the zeal with which this work is promoted by the Government. This circular says:

> The order of July 27, 1893, enacted by the superior council of public instruction, has introduced rifle practice into the programs of elementary schools.
>
> Since the law of March 21, 1905 (reducing the term of service in the regular army to two years), was put into effect, the question of practical organization of that instruction in the schools has assumed an urgent character as never before. This question was the object of a new investigation by a commission composed of representatives of the departments of war and public instruction.
>
> The commission has adopted a number of resolutions which I approved in accord with my colleague, the minister of war, and whose tenor is as follows:
>
> 1. The teachers are most urgently invited to give instruction in shooting at short distance in the schools; it is recommended in case where there is not yet an organization operating to their satisfaction, that they shall proceed to organize small school rifle clubs and to establish, in connection with these, continuation sections intended to secure the extension of the practice until the period of military service and even after, if practicable.
>
> 2. The work thus instituted will enjoy the rights and privileges attached to continuation military training, especially the supplementary leaves and remunerations, as provided for such cases.
>
> 3. The inspectors of primary schools shall report every year as to organization of target practice in the schools of their respective districts and communicate the names of teachers most distinguished in this respect; they shall, for the information of higher administration, indicate in their reports, if appropriate, the reasons why certain schools in their districts have not been able

to organize this instruction and what assistance could be offered them to help them achieve positive results.

4. The instructors must be invited to bring their schools to participation in the contests of primary schools, which are organized annually with my approval by the "Union des sociétés de tir de France."

5. The prefects shall be invited to indicate to city mayors the earnest desire of the Government to have target practice organized in schools of every commune; the prefects shall be also asked to direct, by a special circular to each Department, the attention of mayors to the necessity of their arranging conferences on the subject with the teachers and aiding the latter to the greatest extent possible. They shall be also invited to point out to their general councils the importance of their effective participation in this work.

6. The minister of war, who is authorized by the law to accord some teachers exemption from one of the two periods of service, has decided that these exemptions shall be granted by right to all teachers providing for instruction in shooting in their schools. He will address letters of recognition, with mention in the Official Bulletin, to teachers recommended to him as most distinguished in this work.

7. All rifle clubs formed in the public elementary schools and comprising a continuation course may enjoy the rights accorded by the instructions of June 21, 1904, to mixed rifle clubs.

They shall apply in this connection to the general commander of the division, who will serve as an intermediary between them and the ministry of war.

The circular closes with practical suggestions relating to the organization of school rifle practice.

SOCIETIES OF MILITARY PREPARATION.

The numerous societies of military preparation are federated into "L'Union des sociétés de préparation militaire," composed of 52 departmental federations and committees, with a total number of 1,080 societies and 300,000 members. The union encourages the organization of new societies and offers them active and pecuniary assistance.

The activity of the societies has assumed a more definite form since the institution, by the law of April 8, 1903, of the so-called brevet d'aptitude militaire. The *brevet* is a certificate of preliminary military training conferring upon the bearer certain privileges relating to the period of active service. He is entitled to (1) a special term of service in advance of the date of conscription, (2) choice of the corps in which to serve, (3) special rights for promotion to the rank of corporal or "brigadier," (4) assignment to special services. The brevet d'aptitude militaire is obtained upon passage of an examination prescribed by the law already referred to. The examination may be taken either in advance of the date of conscription or during the service.

GERMANY.

Germany was the first nation to introduce universal military service. The system was initiated in Prussia in 1814 and was soon extended to the other German States, thus laying the foundation of Germany's military organization. Military training of schoolboys was early recognized as an important adjunct of the training of the troops. In 1808 the Prussian minister, Vom Stein, recommended the introduction of exercises in the use of arms in all city schools. Following this action several schools developed programs of military training of considerable efficiency. After the Napoleonic wars, however, the country entered upon a course of military preparedness for all males, which was carried out on a vast and thoroughgoing plan that made the assistance of the schoolmaster no longer needed or desired.

The matter of military training in schools was not again revived until shortly before the outbreak of the European war. The present status of this work is that of a series of emergency measures undertaken both within and outside the schools in order to speed the training of youths approaching the military age so that they may be placed in the trenches as early as practicable. There are, however, several organizations whose activities have been developing for some time and have indications of permanency. These societies are known under the collective name of Jugendwehren (juvenile military organizations). The most renowned is the Jugendwehr of Berlin, founded in 1896, which numbers 600 to 700 members. Jugendwehren do not limit their activities to schoolboys, although the great majority of members are pupils of various schools. The age limits for members are from 14 to 20 years.

The Jugendwehren arrange drills on Sundays in army barracks or vacant grounds. The training comprises exercises in different military services. The Berlin organization is composed of five companies and several separate troops, such as musicians, marine corps, sanitary corps, etc. Many young men who have had this training are given special credit for promotion in active service.

Jugendwehren are often organized in individual schools; membership is then limited to students of the particular school. Such organizations are especially numerous in gymnasia and "real schools."

Among the federations of Jugendwehren the strongest is the Blue-white-blue Union. It comprises 70 juvenile corps, companies, or battalions located mostly in the northern Provinces. There are also various local organizations and unions of organizations with different programs and forms of activities. Some of the unions, like the Blue-white-blues mentioned above, wear distinctive combinations of colors.

As a rule, Jugendwehren pursue military or semimilitary training *without arms.* They arrange long marches, field exercises, and maneuvers, as well as exercises in the activities of auxiliary corps of the army.

The Boy Scout movement has been adopted in Germany in a modified form under the name of Pfadfinder (pathfinders). This organization is of recent origin, but its attraction for boys has made its progress extremely rapid. In 1912 the federation of pathfinders in Germany had a membership of 24,000, with 600 field masters. Pathfinders are recruited among older pupils and graduates of public schools and students of secondary schools. The uniform is similar to that of the Boy Scouts; it consists of a soft hat, jacket, knee breeches, a soft shirt, and belt. The equipment varies according to the kind of work performed. When out for fieldwork, the boys carry trench spades and picks. They do not exercise with arms, but otherwise their activities are decidedly military. The training of a pathfinder includes camp life, with all the requirements of physical endurance, strength of character, and self-reliance that it imposes. Pathfinders learn how to cook their food, how to save lives in emergency, and how to offer first aid. They are taught to orient themselves in forests, to climb mountains, to trail imaginary smugglers or "enemy," etc. They observe a code of personal conduct of a practical nature, comprising numerous instructions relating to morals, hygiene, thrift, etc.

The pathfinders are federated into several State and provincial organizations, of which the Wehrkraft of Bavaria is the most powerful.

In 1911 a new organization for military training of youth was founded in Berlin by General Field Marshal von der Goltz. It is known under the name of Jungdeutschland (Young Germany), and its object is to prepare boys of school age for military duty by means of exercises of a direct military character. Army officers and sergeants act as instructors. The work done by the "Young Germans" comprises drills, gymnastics, bicycling, marching, field exercises, patrolling, small feats of military engineering, etc.

In 1914 a joint decree was issued by the Prussian ministries of war, ecclesiastical and educational affairs, and the interior, requiring that all boys over 16 years of age, not yet in active service, should receive preparatory military training. The measure was to remain in force for the duration of the war. The training provided by the decree is voluntary, but a sort of moral compulsion is applied to the negligent. The communal authorities were charged with the organization of this work. Owing to the disorganization of schools, the measure could not be carried out on a uniform plan. In many localities military instruction is given within the school hours as a part of the prescribed program. The average time allotted to this work is two hours per week; it is generally combined with gymnastics, and does not comprise exercises with arms. Other German States have made similar provisions. In Bavaria military training of youth is conducted on an extensive scale by private societies, with encouragement and assistance of the State government. The Bavarian "Wehrkraftverein," the most important organization for preparatory military training in the Kingdom, made public the program of instruction given to boys over 16 years of age, both in and outside the schools. This program gives an instructive evidence of the thoroughness and efficiency of the training offered in Wehrkraft's units. The full program is given in Appendix I.

AUSTRIA-HUNGARY.

AUSTRIA.

Military instruction is pursued in secondary schools by voluntary organizations of students. These organizations form a national federation, *K. K. Reichsbund der Knabenhorte und Jugendwehren*, with headquarters in Vienna. The federation was founded in 1908. In 1913 the number of federated organizations was 776 with 36,673 members. The funds of the federation amounted, at the same time, to 58,010 crowns. The federation is supported by the Government and was under the patronage of the present Austrian Emperor before his accession to the throne.

An order of the ministry of worship and public instruction, issued in October, 1910, introduced optional rifle practice in secondary schools. This instruction is offered to students of the last two classes of gymnasia and similar schools, and is given by specially trained instructors and army officers. The classes are in session two hours per week, exclusive of holidays and vacations, but not less than 50 hours in a year. The instruction consists of (*a*) theoretical instruction and preliminary exercises, (*b*) blank firing, (*c*) rifle practice with ball cartridges, shooting connected with theoretical instruction, marksmanship matches, and (*d*) estimation of distance.

Rifle practice takes place in school playgrounds, or on military grounds by arrangement with military authorities; the military furnishes all necessary material. Army rifles and ammunition are used, although for preliminary practice special gallery-practice cartridges are furnished, charged with percussion caps only. Students of secondary schools manifest great interest in this work, and in 1912 (according to Körperliche Erziehung, No. 6, 1912) from 70 to 80 per cent of qualified pupils in many schools participated in the shooting classes.

HUNGARY.

Military training preparatory to active service is promoted in Hungary by an organization called "Nationale Phalanx." The boys organized in the phalanx receive general military instruction and practice shooting with army rifles. Special attention is paid to the physical development of the youth. The organization is intended for boys who have graduated from public elementary schools. Besides giving military and gymnastic instruction, it also endeavors to awaken in the boys a patriotic spirit, to raise the level of their moral interests, and to promote national games and songs. In order to popularize its work, the phalanx arranges every year in each district or parish a public competition in games and military exercises.

In secondary schools military instruction has assumed a more formal development. In the school year 1905–6 a *reformed obergymnasium* at Zilah petitioned the ministry of national defense (Honvedministerium) to furnish teachers, rifles, ammunition, and equipment for a course in military instruction organized in the institution. This request was complied with. The course established in the Zilah obergymnasium was for students of the four higher classes, and instruction was given on Sunday afternoons and vacation days. The example of Zilah was followed by several other gymnasia. The Catholic Church administration of the Siebenburg district introduced military training of this kind as an obligatory subject in eight secondary schools under its control. In other schools student societies took the initiative and began to drill and practice in target shooting. The military authorities promptly and willingly lent their assistance to every organization or school applying for instructors, arms, and ammunition.

In 1915 a decree of the minister of education made military instruction obligatory in the last three years of certain gymnasia recognized as situated opportunely for the conduct of such instruction. In the institutions designated only those students are excepted from military training who are recognized as unfit by a school physician or the school authorities.

For the purpose of military drill students are organized in companies of 60 men each. Both regular teachers of gymnastics and army officers (of the reserve force) are employed as instructors. The military instruction partly occupies the time formerly allotted to physical training and partly covers the hours of recreations and games. For field exercises are assigned two entire days and three half days in each school year. The instruction is theoretical and practical and comprises the regular military subjects, except rifle practice, which is pursued by voluntary clubs of students.

In 1903 Herr Von Szemere, a representative in the Hungarian Parliament, founded the first students' rifle club as a subdivision of the university athletic club of Budapest. This action was indorsed by the ministry of national defense and an able officer was assigned as an instructor. At the end of 1912 the number of juvenile rifle clubs in Hungary had grown to 183, with a membership of 7,836. Of this number 5,243 were students of secondary schools. As the total number of students in the last two classes of secondary schools was at that time 9,878, fully 53 per cent of students participated in rifle clubs.

As regards the pupils of public elementary schools, a sort of military training had been given them long before the movement affected the higher classes of schools.

In 1906–7[1] military training was given in 150 elementary schools. The programs of this instruction are said to be very practical and efficient. Special attention is given to estimating distance, the pupils being trained to formulate at sight the distance of different points indicated by the teacher. The skill thus achieved is of great importance in long-range shooting; at the same time the exercise serves to improve the vision of the pupils overfatigued by study.

SWITZERLAND.

Military training in public schools of Switzerland is in the nature of preparation for the soldier's training received later in the active army by every able-bodied male citizen. The system of universal military service of the Swiss Republic provides only for a short period of training, on the assumption that every recruit has received the necessary preparation in his public-school course; therefore, this "preparatory gymnastics," as it is termed, is regarded as of utmost importance for the proper operation of the Swiss military law; in fact, it is an integral part of the military system. The act of April 12, 1907, forming the basis of the Swiss system of citizens' army, gives the main lines of the training required in the schools, in the following articles:

ACT FOR MILITARY ORGANIZATION OF THE SWISS REPUBLIC.

PART III. INSTRUCTION OF THE ARMY.

1. Preparatory Instruction.

ARTICLE 102. The Cantons provide for a course in calisthenics for young men during their school courses. This calisthenic exercise is administered by instructors trained for the work in normal schools and in the schools for physical training masters instituted by the Confederation. The Confederation exercises ultimate surveillance over these provisions.

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[1] No later figures are available.

ART. 103. The Confederation encourages all associations and, in general, all efforts toward the bodily development of its young men from the time of their leaving school until incorporated in the army.

A physical examination takes place at the time of enlistment.

The Confederation imposes restrictions upon the preparatory physical instruction. It organizes the schools for monitors.

ART. 104. The Confederation similarly grants subsidies to associations and, in general, for all attempts having as object the military instruction of its young men before the age of military service. The Confederation sees that instruction in firing is made of primary importance, and gratuitously furnishes arms, ammunition, and equipment. The Federal Council fixes the necessary regulations.

As now in operation, the preliminary military training is conducted in two forms: (*a*) Compulsory "preparatory gymnastics" given in public schools as a part of official programs, and (*b*) voluntary drill and rifle shooting given outside the school, in cadet corps organized in accordance with article 104 of the act of 1907.

Preparatory gymnastics.—Regular attendance at the classes of preparatory gymnastics is obligatory for boys during the entire legal school age; children can be excused from taking this instruction only by special permit of the war department. This subject is taught by specially trained instructors, and is given a minimum of two hours per week in every school year.

The course is divided into three parts comprising, respectively, the ages: (1) From the entrance to and including 9 years of age, (2) from 10 to 12 years, and (3) from 13 years to the end of the school period. In the first part instruction consists mainly of games and free exercises. The last two parts embody the regulations of "physical training schools for preparatory military instruction" for which special manuals have been prepared by the Federal authorities.

A detailed program of the instruction comprised in each part of the course is given in Appendix II.

Voluntary cadet corps.—The voluntary cadet corps are organized in three groups, according to the kind of training pursued; there are corps for drill with arms, without arms, and for target practice. The Federal Government encourages the establishment of new corps and the development of those existing by an untiring activity in the form of circulars to teachers, prizes and subsidies to students, issue of rifles and ammunition, etc. As the ultimate aim of this work is to attract every boy to some sort of preparatory military training, special emphasis is placed on the complete representation of every school in the enrollment; for this purpose the cooperation of the teachers is solicited by the Federal Government.

Instruction in the cadet corps is given by army officers. Members of each corps wear distinctive uniforms. For target practice the Federal Government furnishes light rifles and ammunition. To encourage this practice a prize of 5 francs is given to each cadet who comes up to a certain standard of proficiency in marksmanship.

The growth of the cadet corps since the enactment of the military law of 1907 has been steady, and the interest of the boys in this work is such that practically every Swiss school boy is enrolled in some voluntary cadet corps.

The establishment of the "Cours des jeunes tireurs," corps specially devoted to target practice, was at once attended with great success. The enrollment in these corps in 1910 was 1,141; in 1912 it increased to 2,397.

The drill corps have likewise made considerable progress. From a membership of 10,950 in 1908 they increased during the four years ending with 1912 to 12,821 drilling with arms and 8,744 drilling without arms, or a total of 21,565.

SWEDEN.[1]

Compulsory military training was introduced into Swedish schools about 50 years ago, in connection with the rifle-volunteer movement which at that time began to make progress. About 10 years ago the military exercises were altered to rifle practice, i. e., the training concentrated more upon shooting than upon ordinary military drill. Rifle practice is not given in elementary schools, excepting those in Stockholm. It is compulsory, however, in all public secondary schools (die deutschen Gymnasien), the age limits of training being 15 to 18. In Sweden there are only a few private secondary schools, and in some but not all of these instruction in rifle practice is given. Moreover, it is given in technical schools of secondary type and in training schools for teachers. Military training forms a part of the ordinary course of secondary education; consequently the Government appropriates a sum of 50,000 Swedish crowns annually to supply rifles, ammunition, ranges, etc.

The boys devote 60 hours yearly to rifle practice, the time being distributed over the first 15 week days of every school year during the last four years of the course (i. e., from 15 to 18 years of age, inclusive). Four hours each day on these prescribed days are spent in military exercises, the remainder of the day being occupied with ordinary school work.

Instruction is given by special instructors appointed by the secretary of state for war. In general, they are the teachers of gymnastics of the respective schools. These instructors are in most cases men on the active-service list. A Swedish authority considers that the training has produced an undisputed beneficial effect on the boys, and has made them well fitted for their subsequent military training in the Swedish Army.

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[1] A. B. Wood: The Military Training of Youth in Schools. A report, based on official information, read before the Section of Educational Science of the British Association, at Manchester, Sept. 9, 1915.

NORWAY.

Military training in the form of what might be called professional drill is not given in Norwegian schools. Although rifle practice is not compulsory, it is promoted by voluntary courses and is extremely popular with the youth of Norway. It is also encouraged in the schools by large Government grants.

ITALY.[1]

In Italy, outside of the special military schools, military training as such is given only in what are called "national colleges." These institutions are controlled and subsidized by the Government. In scope they correspond to the gymnasia, but are all boarding schools; the students wear uniforms and are under discipline all the time. Twice or three times a week they are obliged to attend military drills comprising exercises with and without arms and rifle shooting.

As regards other schools, no military training is prescribed, but various military and semimilitary clubs have numerous followers among the school boys. The most popular of these are the Ricreatori, organizations arranging Sunday recreations in the form of gymnastic exercises, marches, drills, etc. Members of these organizations wear uniforms and usually have a brass band accompanying them in public exhibitions.

RUSSIA.

Military drill is given as an optional subject under the name of gymnastics in all primary and secondary schools for boys. The instruction consists of marches and various military formations, setting-up exercises, and some elements of physical training. The training is given by army officers or noncommissioned officers. Most secondary schools have their own brass bands. All students of public schools wear distinctive uniforms of military pattern, which, however, have no relation to military education.

An attempt to introduce gun practice in the gymnasia was made in 1915, according to press advices, but no recent official reports confirm this information.

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[1] Statement by Baron Pietro Arone di Valentino, first secretary of the Italian Embassy, Washington, D. C.

NETHERLANDS.

The work of military training of school youths is carried on in Holland entirely outside the schools by societies specially organized for this purpose. The most popular form of this activity is that of summer camps. The camps are organized for schoolboys over 15 years of age and are of 14 days' duration. This time is devoted by the boys entirely to physical and military exercises; swimming, and games. Target shooting and field-service drill are regularly practiced in the camps. The authorities provide for this purpose, without cost, instructors and physicians, as well as arms, ammunition, tents, blankets, and all other supplies that may be required.

Summer camp societies occasionally make arrangements for the boys in the summer camps for long excursions, either walking or bicycling.

Two organizations similar to Boy Scouts have recently developed in Netherlands. They are "Padvinders" (pathfinders) and "De Jonge Verkenners."

GREECE.[1]

Military gymnastics and rifle shooting have been recently much encouraged in the secondary schools of Greece. In 1911 rifle practice was prescribed for the students of gymnasia, institutions with a four-year course, corresponding to the American high schools. Instruction in shooting is given twice a week. Every year intercollegiate matches in target shooting are held in the larger cities. These matches are known as Σωτήρια (salvation), commemorating the failure of an attack upon the life of the late King. In Athens, where such contests are attended with much festivity, the King personally distributes the trophies.

Other annual games take place in various centers at Easter. In these games teams of pupils representing different primary schools compete in physical exercises and military movements. The best teams are awarded diplomas or trophies.

Physical training is given in all primary schools, and comprises, as a rule, simple military drill.

The Boy Scout movement is also rapidly gaining in popularity among schoolboys in Greece; it must be observed, however, that Greek Boy Scouts have strictly military organization, and the work done by them is in the nature of true military training.

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[1] Statement by M. A. Vouros, Greek chargé d'affaires ad interim, Washington, D. C.

JAPAN.

Military training has a firm position in the Japanese school system, owing partly to the tradition assigning to military arts a prominent function in the education of boys, and partly to the modern development of military power in the nation.

In public schools military instruction is given in connection with gymnastics, but by separate teachers, mostly retired officers and noncommissioned officers.

Gymnastics and military instruction are taught in every school, the time allotted to these subjects varying from three to six hours per week.

The extent of military instruction in the several kinds of schools is shown in the following excerpts from official programs:

Elementary schools.—Military drill is obligatory for boys above 5 years of age. In the higher section of the course the drill consists of individual and section exercises.

Middle schools.—Military gymnastics is given throughout the course. It consists of horizontal-bar, shelf, wooden-horse, and parallel-bar exercises. Military drill consists of individual, section, and company drills, blank firing, and mimic fighting. Fencing and jiujitsu are optional.

In *higher schools, special colleges, and technical schools* of all grades gymnastics, including military drill, still forms an important part of the curriculum. In medical colleges military drill is practiced in the first year only.

MEXICO.[1]

Military training has been practiced in Mexican schools for over 25 years. As early as 1889 a national congress of teachers adopted a recommendation to State governments urging the introduction of military training in every school in the country. This recommendation was later acted upon by the legislative powers of the several States, with the result that military instruction was introduced in every Mexican school where competent instructors could be secured. A recent decree issued by First Chief Carranza gave added sanction and new stimulus to this work.

The regulations generally adopted provide as follows:

In elementary schools military training commences with the third grade, at the average age of 10 years. Regular classes are held twice a week, half an hour each; once every week there is drill in larger bodies, for which students of several schools are brought together.

In the third grade the training consists of free exercises and simple drill in individual movements. In the fourth grade pupils receive wooden dummy rifles and are trained in exercises with arms up to and including the battalion formation.

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[1] Statement by Prof. Gregorio Torres Quintero, chief of the department of education, State of Yucatan, Mexico.

The supply of competent instructors is secured by means of the thorough military training given in normal schools. Later, while pursuing their vocation, teachers are given the benefit of frequent conferences with Army officers in order that they may keep their military instruction up to date.

The course of public elementary schools in Mexico covers four years. For continuation study there are higher primary schools with a two-year course. These include an advanced course of military training in which much attention is given to rifle practice. For target work the students use service rifles of Mauser pattern and full-charge ammunition.

This work is continued in high schools, where target practice and drill with arms are pursued on a more extended scale.

ARGENTINA.[1]

Military training is obligatory in the last two years of public secondary schools, including national colleges, superior schools of commerce, superior industrial schools, and normal schools for teachers. The course of the secondary and normal schools covers from five to six years, the entrance age being from 14 to 16 years. Hence the students do not begin their military training until they are at least 17 years old. Private schools of corresponding grades have similar programs of military instruction.

The military training required in the last two years of the secondary school course is very thorough. It consists of drill with and without arms and rifle shooting, and occupies five hours per week. The instructors employed in this work receive careful training in a special institution called Escuela normal de educacion fisica. They must be graduated teachers, besides being experts in physical education. The army instructors employed are also graduates of special training schools.

Special attention is paid to target practice, for which purpose the Government furnishes service rifles (Mauser carbine, Argentine model) and ammunition. Both indoor and outdoor ranges are used. Target shooting is often done in teams representing various schools, which tends to stimulate the zeal of the students in this work. Those who have established a perfect record in marksmanship receive special credit in the form of one year's exemption from active service.

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[1] Statement by Mr. Rómulo S. Naón, ambassador of Argentina to the United States, late minister of public instruction of Argentina.

BOLIVIA.[1]

Military training in the strict sense of the term is not a feature of the schools of Bolivia, but some exercises in simple military movements are included in the physical training which is given, as a rule, in elementary and secondary schools.

The Boy Scout movement has developed recently to a great extent, the organization following the same lines as in England or the United States. Special importance is attached to long excursions, in which the boys march in troops to distant points for the purpose of rendezvous with other units or simply for the mental and physical benefit derived from such excursions. The physical strength thus developed is indicated by the fact that the distance covered in a single excursion often exceeds 70 or 80 miles.

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[1] Statement by Señor Don Ignacio Calderon, envoy extraordinary and minister plenipotentiary of Bolivia to the United States.

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APPENDIX I.

PROGRAM OF PREPARATORY MILITARY TRAINING IN BAVARIA.

1. Quick, silent movements in line and column, either at halt or at marching in a given direction.

Division of the school into platoons and squads, carried out as in company drill.

2. The formation of a skirmish line and quick, silent assembling. When assembling the men are required to take proper alignment and intervals without command.

3. Simple marchings in column with change of direction on command and signals.

4. Exercises in marching in accordance with hygienic instructions. Regulation of step length and cadence. Long, easy step must be insisted upon.

5. Terrain exercises and singing national songs may take place during the march.

5a. Simple exercises in security services on the march.

6. Formation of a skirmish line and its movement in conformity with a given terrain; these exercises should be occasionally interrupted by assembling in order to secure quick response to command.

7. Every movement of juvenile units should be smart and cheerful without, however, affecting the accuracy of the drill. Immediate and accurate execution of all commands, orders, and signals of the commanding officer is an absolute requirement.

8. Elements of knowledge of terrain, its importance and utilization in combat, connected with data relative to modern fire efficacy.

9. Description of terrain, with short, exact specifications of small objects, preliminary to the practice in examination and description of the target.

10. Visual exercises of various kinds.

11. Distance estimating.

12. Prompt naming and discerning of similar objects.

13. Mnemonic exercises with the view of preparing the pupils for reporting orally their observations.

14. Hearing exercises.

15. Making correct conclusions from observation of terrain.

16. Accurate and true reporting upon observations made; also reporting service generally.

17. Correct repetition of short orders.

18. Exact orienting of others in a terrain.

19. The use of the watch, compass, distance measuring apparatus, and the knowledge of Morse code.

20. The use of maps. More attention must be given, however, to the development of sight and hearing.

21. Flag signaling.

22. Field gymnastics.

23. Small emergency works: Tying knots, recovery of floating objects, use of rafts, making emergency boats, building log bridges, crossings of various kinds, construction of tents, cabins, dugout fireplaces, kindling a fire and cooking, camp works.

24. Emergency stretcher. First aid to wounded.

25. The utilization of terrain for cover and for approaching the enemy.

26. Position and digging-in of a skirmish line.

27. Quick movements from cover to cover, both in advance and retreat.

28. Instruction in mutual assistance.

29. Advance guard service; how to place the advance guard detachments, etc.

30. In all of the above exercises every opportunity must be used to employ the youths in independent errands in the services of orderlies, in transportation, relay, and scouting, in order to develop their resourcefulness, dependability, and trustworthiness.

31. All means must be used to train the youths in endurance and strong will. No task once undertaken should be given up. Every one must fulfill his duty to the end.

32. Purely physical training in free exercises, gymnastics, running, games, etc. These should be short but given frequently.

33. Theoretical instruction in evening hours and in bad weather.

APPENDIX II.

PROGRAM OF PREPARATORY MILITARY TRAINING IN SWITZERLAND.

PART 1.

First year (7 to 8 years).—Drill (position and alignment). Facing by jumps, individually. Simple arm and leg exercises. Marking time, marching in circle and serpentine; marching with songs. Equilibrium on a bench. Preparation for a jump. Simple games. Breathing exercises.

Second year (8 to 9 years).—Drill (fall in and fall out). Position in double ranks. Simple arm and leg exercises. Exercises preparatory to gymnastics with apparatus. Quick-time marching, countermarching, half-step and tip-toe marching. Exercises in equilibrium. Simple jumps. Games. Breathing exercises.

Third year (9 to 10 years).—Drill in close-order formation (formation of a column, opening and closing the ranks). Arm, leg, head, and trunk exercises. Change of step in marching; double-time. Simple exercises with apparatus. Various jumps. Games. Breathing exercises.

PART 2.

Fourth year (10 to 11 years).—Drill in close-order formation (turning individually and by elements). Combined exercises, arms and legs, head and trunk. Suspension exercises (wall, ladder, horizontal bar, and climbing pole). Marchings in various steps and in double-time. Exercises of support (beam and parallel bars). Various jumps. Games and swimming. Breathing exercises. (Official manual, first year.)

Fifth year (11 to 12 years).—Review of close-order drill of the preceding year. Simultaneous exercises of arms and legs, arms, and trunk. Various marchings. Gymnastics with apparatus. Various jumps. Games and swimming. Breathing exercises. (Official manual, second year.)

PART 3.

Sixth year (12 to 13 years).—Drill in close-order formation (taking distances and intervals). Free exercises with canes putting in action different parts of the body. Various marchings. Gymnastics with apparatus. Exercises in equilibrium. Various jumps; jumps with obstacles. Games and swimming. Breathing exercises. (Official manual, third year.)

Seventh year (13 to 14 years).—Drill in close-order formation. Free exercises and exercises with canes. Gymnastic with apparatus. Oblique marchings, marchings by squads, platoons, etc. Various jumps, with obstacles, etc. Games and swimming. Breathing exercises. (Official manual, fourth year.)

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GARDEN CLUBS IN THE SCHOOLS OF ENGLEWOOD, NEW JERSEY

BY

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GARDEN CLUBS IN THE SCHOOLS OF ENGLEWOOD, NEW JERSEY.

AUSPICES.

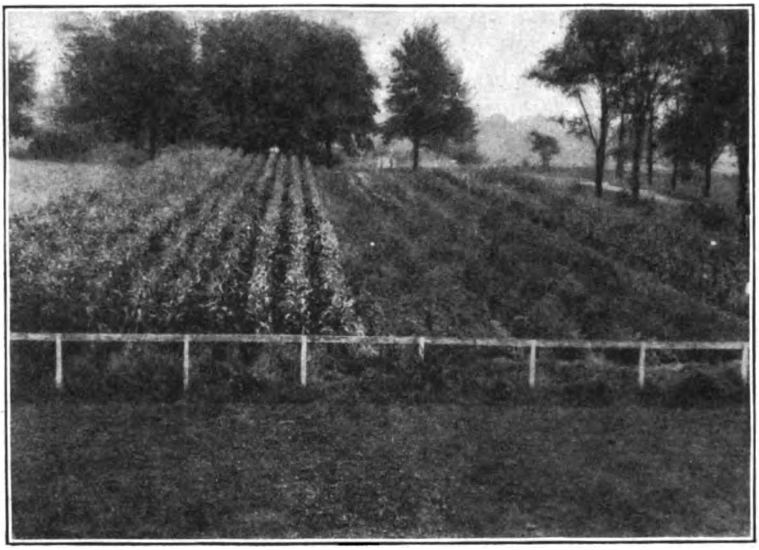
The garden clubs of the Englewood schools were organized during the summer of 1916 and were directed by the local board of education and the superintendent of schools through a supervisor of gardens employed for this special purpose. Owing to the experimental nature of the work and the lack of funds at the command of the board of education, the enterprise was financed in part by the Civic Association of Englewood and in part by the State of New Jersey, under the provisions of its manual training laws. In July, 1917, however, that part of the expense hitherto met by the Civic Association was assumed by the board of education.

PART OF THE SPRING TRIALS FOR A STEADY JOB.

PHYSICAL AND SOCIAL ENVIRONMENT.

Englewood is a suburban residential city of about 12,000 inhabitants. In its vacant lots and back yards it has an abundance of land suitable for gardening. Much of the city lies in the desirable sandy loam soils of northern New Jersey. It is not a locality without obstacles, however. A considerable part of the inhabited area is on the swampy lowlands at the head of the New Jersey salt meadows, and another section is on the rough western slope of the Hudson River palisades, where suitable locations are difficult to find.

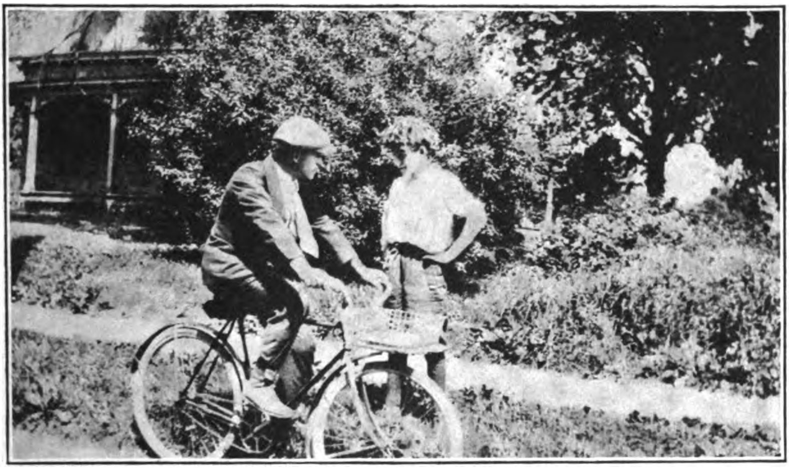
Many of the children's homes are dingy quarters in crowded tenements throughout a limited congested district in the low-lying area, so that the contact with nature afforded by the garden work is wonderfully inspiring; and it is especially gratifying to the interested adults. For instance, one high-school boy, who in the spring of 1916 planned great things, said that he had no place for a garden but suggested carrying a little earth to the roof of the tenement


THE GARDEN IN MID-SEASON.

"WHAT HAS EATEN INTO THE HEART OF MY CORN STALK?"

in which he lived. He is now operating a garden of 3 acres in partnership with two other boys. What a little garden work will do for a boy is also brought out by another member of the same partnership. He is the only one of the three who has the good fortune to live in a house surrounded by a yard. In the spring of 1916 this boy displayed his lack of knowledge concerning the out-of-door world by saying, "Last year I planted some seeds about a foot in the ground, and I don't see why they didn't come up, because I sure did plant them good and deep." The fact that he has undertaken a task as large as tthe pesent one is in itself proof of what he has gained.

Aside from the common-sense information concerning the out of doors derived from such an enterprise as these boys are undertaking, the business training secured by planning, managing, selling the products, and recording the results of their work is of significant value to all the children, very rich and very poor, and of perplexing racial differences such as are found in the suburbs of a great city. All kinds of business, from the most gigantic commercial and banking undertakings known to New York City to the most limited second-hand dealing and pawn brokerage, will be the life work of these boys, sons of men who are at present engaged in such occupations.


MANY TIMES A QUESTION ANSWERED ALONG THE STREET HAS IMPORTANT RESULTS.

As in all other public-school activities, equality of opportunity is especially marked in the garden club groups. The home life, as well as the school life, of each member becomes familiar to the others of the group, with its undeniable influence in bettering that of all the members. In this association, it is almost impossible for any member to overlook the sterling qualities in his club mates. Community of effort teaches helpfulness and cooperation, not by theoretical expression, but by vitalized experience. The boys from the rich homes and from the poor find much in common.

ORGANIZATION.

Registration.—When the proper time came the superintendent of schools briefly explained the undertaking to all the children of each school in a general assembly. The supervisor then gave some further instructions and distributed registration blanks.[1] These were taken home by all the children electing the work, filled out, and returned the next day. At this time the supervisor of gardens went over the slips with the principal of the school, whose approval every participant was required to have. If the blank was not satisfactorily filled out, but the child approved, the parents were visited by the supervisor and the blank corrected. Each child who was thus registered then took complete charge of his project, which he was expected to carry out with the supervision and advice of his parents and of the supervisor of gardens. The project, aside from caring for a garden, included the maintenance of a careful record[1] of all activities connected with it.

A GROUP OF GIRLS LEARNING HOW TO SPADE.

The records of the children.—This record when complete contains certificates of recommendation and approval; personal information concerning the child; a photograph of the child in his garden; a working plan of the garden drawn to scale; an itemized and summarized financial account; a record of marks given the garden by the instructor on visits to the garden; and a story of the season's work in essay form.

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[1] See section on "Blanks and Circulars" (p. 29) for this record blank.

Division of pupils.—All the children undertaking the work were organized into clubs of about 15 members each, of about the same age, of the same sex, and from the same school. By this plan all the homes of the children in each club were close enough so that each member could see what the others were doing. Each club was organized and conducted by the children under the direction of the supervisor. The clubs were merely a division of the children for convenience in supervision and instruction.

A competition.—The members of each club competed among themselves for inexpensive prizes. The children were to have been marked on the basis of 100 per cent as perfect, with one-third of the credit coming from their garden, one-third from their records, and one-third from the showing which they made at the exhibit. This method of calculation had to be abandoned on account of the board of health ruling, however, and instead, three-fourths credit was given on the garden and one-fourth on the record. The premiums awarded on this basis were buttons from a progressive series designed to be awarded for achievement. The same series is used in the boys' and girls' clubs of the United States Department of Agriculture. From each club the contestant having the highest average was given one of the first buttons of the series made of rolled gold. The contestant having the second highest average was given one of the same buttons made of sterling silver. All the other members having an average of 75 per cent or above received a bronze button of the same design. The competitor who had the highest average of all the pupils of all the clubs received one of the second buttons of the series made of solid gold. The same series of buttons will be used progressively in the future.

ANOTHER GROUP IN THE SAME YARD RAKING THEIR PRACTICE PLAT.

Just as the individual members strove for excellence among themselves, so did the clubs and the schools. The school having the highest average among the garden club members attending it was given a banner. This banner is the first in a series designed with a similar idea as that carried out in the buttons awarded to the individual prize winners.

This plan of premium awards always leaves something open to be achieved. It is inexpensive and makes possible the awarding of many merits. This in turn gives every child an ample chance to start toward the final goal. If a pupil does good work but does not stand first, he is given something to show for his efforts and something as a basis to work on in the future.

Meeting places.—The meeting place of each club gathering was determined by the object of the special meeting. The preliminary planning and ordering of seeds was done in the schoolhouse. Demonstrations in garden preparation, seed sowing, and cultural methods were held in back yards and vacant lots. Street corners were used as meeting places for starting trips to the surrounding commercial trucking region. Two of the older groups met in one of the school yards several times to aid in the construction of hot beds and receive instructions for building them.

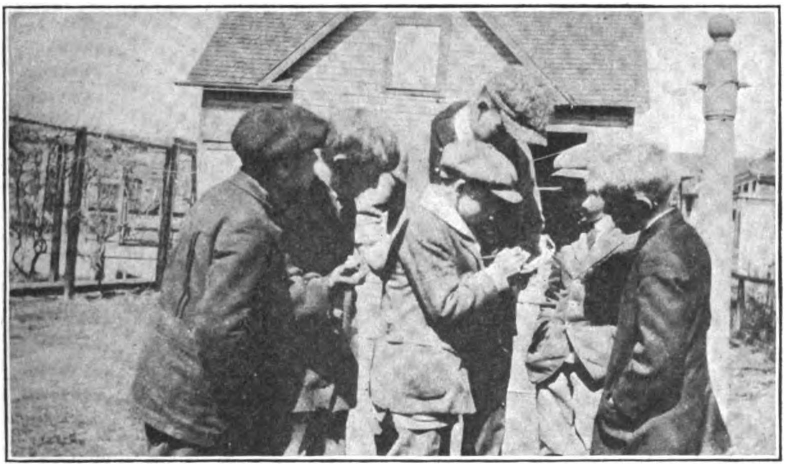
ONE WAY OF COVERING SEED.

INSTRUCTION.

The methods of instruction varied in accordance with the season. During the late winter and early spring the classroom method was followed. Necessarily the work done at this time was varied. Some of the time was spent in talking over the different garden practices and methods, some in seed-testing demonstrations, and some in drawing plans and working out schemes for the summer's work.

Just as soon as the ground could be worked demonstrations were held to illustrate the problems which would be met by the children when they started to work their gardens. With the least experienced children, and there were many with no experience, the most difficult task was to teach them how to handle garden tools. The handling of tools combined with their many uses comprised a problem difficult to the small beginners.

Along with the classroom work and demonstrations, postcards and circulars of different kinds were found valuable. Several short leaflets on timely subjects were written and distributed by the supervisor. Publications of experiment stations, and one of a seed firm, were also used.



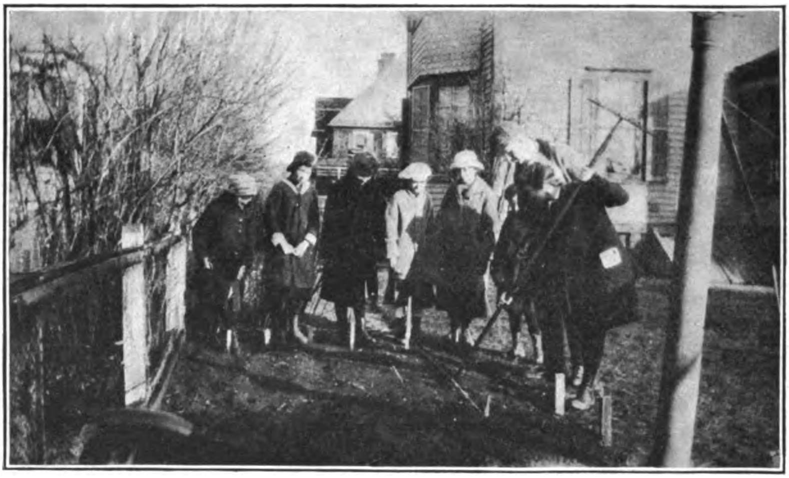
ALL SEEDS PLANTED ARE CAREFULLY LABELED.

A still broader view of vegetable gardening and agriculture in general was afforded the children through automobile trips into the rural districts. Englewood lies near some of the best vegetable, fruit, poultry, dairy, and general farms of New Jersey. Many of these were visited. The trips proved to be greatly enjoyable and inspiring, as well as instructive to the children.

Without doubt the most valuable instruction of all was that offered to each child individually. As in all cases of practical agricultural teaching, the school garden instructor, when dealing with a class, must treat his subject for the most part in general terms. It is difficult for anyone to put these generalities into practice under a variety of unexpected conditions. For the child it is next to impossible. Consequently, a question answered at school or on the street was of particular value to the work, but most satisfactory were the instructions given in the individual gardens.

Vegetable gardening, on a larger scale than is usually possible in the back yard of a city lot, was taught by means of a demonstration garden. Since it served as an ideal for many people, and offered experience of a rather extensive sort to a considerable group of boys, it will be described somewhat fully.

The demonstration garden.—About an acre of ground located on one of the main streets, just opposite a school building, was used during the summer as a demonstration garden. This was planted with three varieties of sweet corn, three of tomatoes, two of egg plants, two of peppers, two of turnips, three of radishes, endive, and potatoes. It served as a working place for several boys who were chosen on a competitive basis to do the work. The chief value of the garden came as an object lesson to the community.



MAKING A STRAIGHT SEED TRENCH WITH THE USE OF A GARDEN LINE AND THE HANDLE OF A RAKE.

The planting was done by the school janitor and the instructor, with the aid of several of the boys who were more than glad to lend a hand. At the time of planting, the ground was in rather poor condition, as the weeds which were previously growing on it were not entirely covered in plowing. Thus by the time the crops were large enough so that hoeing and weeding could be started, they were nearly hidden with weeds. Some of the daisies were actually in bloom. This made an excellent opportunity for trying out prospective workmen, although the conditions for a successful garden were far from perfect. The garden had to be gone over several times during the first cleaning, whereas once would have been sufficient if the land had been more carefully plowed and harrowed.

During most of the summer there were but two boys working on the garden at one time. These were selected from a large number who originally applied, by a competitive system based mainly on the amount and quality of work which they accomplished while not under supervision. At the time, they did not know that they were being watched, although they did realize that if their work was good enough they would be given permanent employment. In this way trustworthy boys were chosen, and as a result very little supervision was needed to carry on the work successfully. The part of the project which required the most time on the part of the instructor was the supervision of the marketing.

The size of the project made possible a great deal of instruction which would have been impracticable on a smaller plat of land.

SOWING THE SEED.

The boys were taught to operate wheel hoes, as well as to remove weeds, and to make a dust mulch with their hands and a garden hoe. They were taught to tie tomatoes in several ways and to compare the results with those which were not tied at all. A small sprayer gave them an opportunity to learn about spraying, the mixing of spray materials, and the function of each ingredient. When the crops were harvested they learned something about salesmanship. All work done during the day was recorded at night.

The boys who worked at the garden were paid 15 cents an hour, except for selling, for which they received a commission of 20 cents on each dollar's worth of vegetables they sold. In this way the boys, all of whom ranged in ages from 10 to 15 years, were able to earn good wages. The plan was so satisfactory to the boys that 33 such gardens were started in the spring of 1917 as individual undertakings.

Assignment of plats.—With the exception of the children living in the congested part of the city, most of the garden club members had their plats in their back yards. The children who lived in the tenements and in other buildings of the same neighborhood were provided with plats of a reasonable size near their homes. These were located in two vacant lots. One was occupied by boys and the other by girls. The vacant lots were staked off into plats of different sizes to meet the needs of different children, and each plat was surrounded by a path 2½ feet wide. Each child was assigned to a plat of his own in the spring, which he was required to spade, plant, and care for throughout the season. Any child neglecting to care for his garden and the surrounding paths in a satisfactory way was deprived of further use of it.

TRAINING TOMATOES.

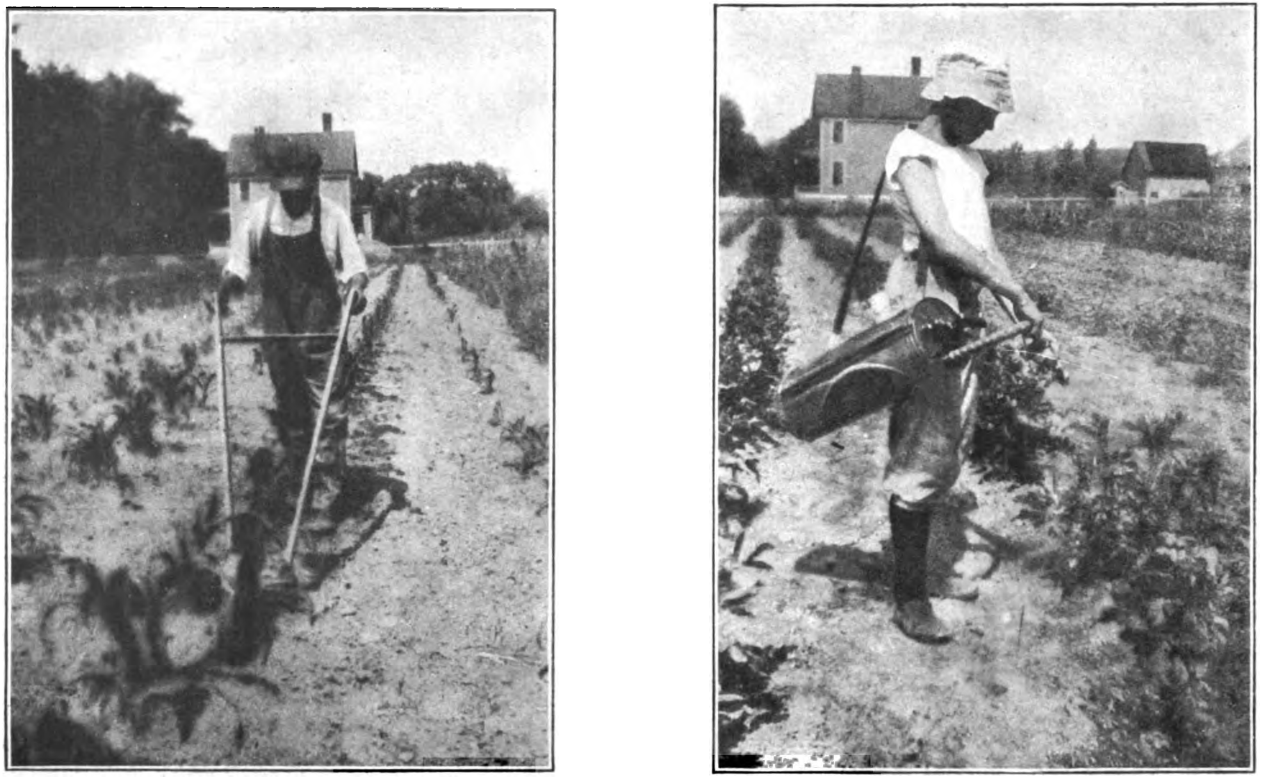
PRELIMINARY WORK, SOIL PREPARATION, PLANTING.

Garden planning.—Actual operations went hand in hand with instruction, which was in most cases very minute. This was especially true while the children were drawing to scale preliminary working plans of their gardens. A great deal of individual instruction was necessary at this time for two reasons: First, because of the varying knowledge of the subject among the children; and, secondly, because of the completely different problem which each child had to solve. Many children had never had any garden experience at all; some had helped their parents who were experts, and were familiar with the growing habits of plants, garden equipment, and the use of fertilizers and sprays. These differences of gardening knowledge, combined with just as great differences in knowledge of arithmetic and drawing, shown by the children in putting on paper the plans for the summer, made the preliminary planning especially difficult for each child. To add to the difficulty each child had an individual problem to solve. Every garden differed in topography, shape, size, soil, surroundings, and vegetables to be grown. As a result, every drawing was different, and the scales used in drawing were in many cases necessarily of a different degree to accommodate the differences in the sizes of the gardens. This makes plain the necessity of the careful individual instruction which was required while the children were doing this part of their work.

Preparation of soil.—The same minute care was necessary when the time came for preparing the garden. Each child, if large and strong enough, was required to do his own work. All were told at club meetings and shown in groups at demonstrations just how to clear off the land, fertilize, spade, and rake the soil. Their varying knowledge in regard to these points also made individual instruction necessary. The combination of factors unknown to the children were not so numerous in this work as in garden planning, however, which made demonstrations especially helpful, and reduced the amount of individual instruction necessary.

SELLING THE PRODUCE.

Clearing off the land.—The two great obstacles in clearing off the land were the accumulations of rubbish and the dense growths of briers and small trees. Near the center of town, vacant lots and many back yards were covered with heaps of tin cans, old shoes, umbrellas, bottles, and all the other things that go to make up a real trash pile. More difficult to remove than these, however, was the vegetation which was most common in the outlying parts of town. Here each brier and sapling had to be removed root and all, a task which in many cases proved long and difficult. In all cases of clearing the soil,



TOOLS PRACTICAL IN LARGE GARDENS WERE USED.

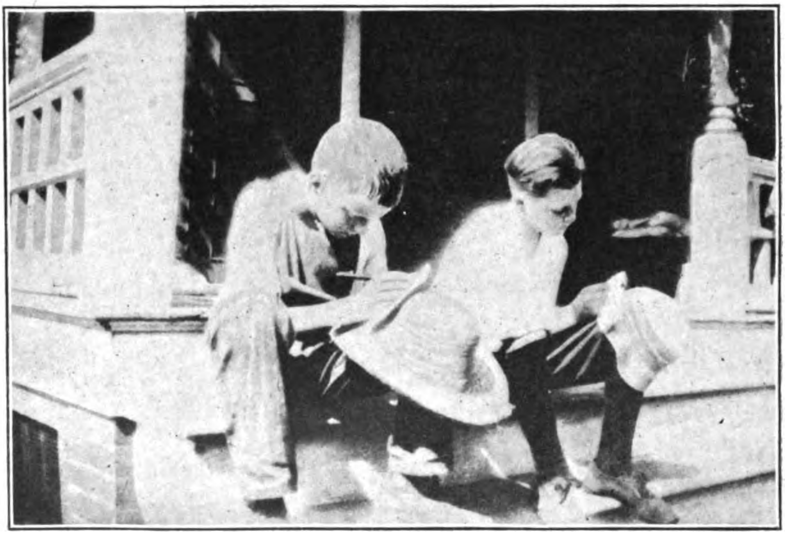
however, the supervisor found that if he himself entered into the work, soon the boys of the whole neighborhood would be on the ground ready to lend a hand.

Spading.—After the soil was cleared, spading was the next operation. Here again individual instruction had to accompany the work of the children. Especially was this the case among the children of the tenement district. All steps—including the pushing of the spading fork deep into the ground; the easy way of lifting it when full of soil; the turning of the surface rubbish, manure, and sod down and the loose soil up; and the breaking of clods—were of necessity carefully explained.

Raking.—The knack of making a smooth seed bed with a rake, which comes only with much practice, was apparent in the final work of only a comparatively few children. All but a very few, however, did manage to get their gardens into fairly good shape for planting after much effort with both edges of the rake.

IN THE CORNFIELD.

Planting.—In sowing seeds and moving plants, most of the children made their rows straight and parallel by means of a garden line and a rule. Some, however, used a board where the rows were short. They made their trenches with a rake handle, the back edge of a rake, a hoe, or the edge of a board. In some cases the seed was scattered by taking a handful and working it over the index finger with the thumb. In other cases the seed envelope was cut straight across one end and the seed distributed by shifting the envelope to right and left with the cut edge above and parallel to the trench. When the time came for covering the seed and firming the soil, most of the children liked best to do the work with their hands. Others used the back edge of a rake, and some made a plow of their feet, taking short steps as they covered the seed and firmed the soil at the same time. While the latter method is amusing to the children, it is not very satisfactory. In moving plants the soil was carefully firmed about the roots. The most diligent of the children labeled each row in their garden with a stake. This bore the name and variety of the vegetable, the name of the seedsman, the dates of planting and transplanting.



THE WORK DONE DURING THE DAY WAS RECORDED AT NIGHT.

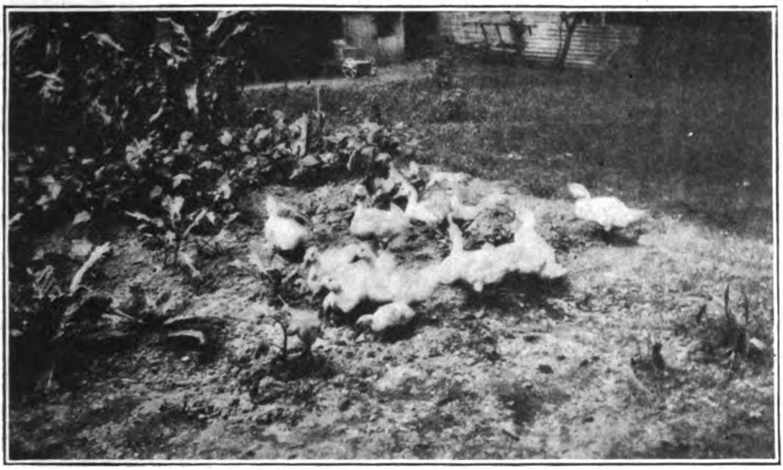
SEEDS.

The necessity of using good seed was impressed upon the children through bringing out the importance of labeling everything planted, so that a complete record could be kept of the seed used and its desirability. Seed-testing demonstrations during the late winter served the same purpose. At every opportunity the importance of dealing with reliable seed firms was impressed upon the children.

The seeds used by the children were purchased from well-established dealers. A few were donated. They were all procured in wholesale lots and then put up in small packets by some of the children under the direction of the instructor. Each packet was labeled by means of a rubber stamp as to the kind of seed it contained, the variety, the seedsman from whom it came, and the approximate date for planting.

The instructor's corrected copy of the rough working plans of each child's garden was used in place of an order sheet for each child. This was done by estimating from it the number of packets of each kind of seed which the child would need. This copy of the garden working plan and the packets of seeds necessary for each child were put into a large envelope which bore the name of the child to whom it was to be delivered.

The value of each child's seeds was also put upon the envelope. The total cost of the seeds was divided among the children as accurately as estimates of possible sales allowed. Each child was charged proportionately as the amount of seed he purchased bore a relation to the total amount of seed purchased in bulk for all. This method of handling the seed proved very satisfactory, but unless a great deal of seed is to be distributed it would be more convenient to purchase the seed from some commercial house which is equipped to make up small orders such as children are likely to need.



DUCKS, TURKEYS, SPARROWS, GOATS, DONKEYS, COWS, AND OCCASIONAL UNSYMPATHETIC CHILDREN ARE PESTS TO BE GUARDED AGAINST.

OTHER SUPPLIES AND EQUIPMENT.

Early plants.—Most of the plants used by the children were purchased by them directly from the local dealers. Some were given to the children by neighbors. A few were donated to the organization, which in turn distributed them among the children. There was no set method used by the clubs for furnishing plants to the children. During the coming season provision will be made for this branch of the work. Some members have built hotbeds, in which they will grow their own plants.

Fertilizers and spray materials.—Children were instructed in regard to the application of fertilizers and spray materials, and were encouraged to use both freely. In so far as fertilizers and spray materials were used, they were procured by the children independently of the clubs. Stable manure was probably the most common fertilizer. The children were also told to save any wood ashes, leaves, or other litter which they might have, for composting.

Tools.—With the exception of the tools furnished to the children from the crowded section of town, the tools employed belonged to the garden owners or their parents. The children who had plats furnished them generally needed the tools provided also. There should be a well-equipped garden house at every group of gardens operated by children who do not have their gardens in their back yards. The children should be free to go for their tools at stated times when there is some one present to distribute them.

A NOT UNCOMMON PEST, BUT EASILY CONTROLLED:

CARE OF THE PLATS.

The plats were in most cases cared for by the children alone. Some children received no instruction except from the supervisor; others were taught also by able parents and friends. This is the ideal way if the parents do not do too much.

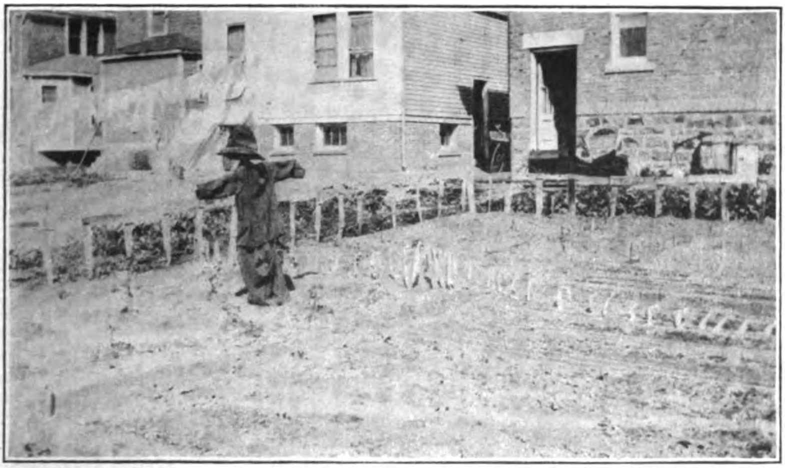
Most of the children did their weeding and cultivating with hoes, rakes, and hand weeders, and by hand. A few had the use of a hand cultivator. More hand cultivators will be used in another year.

Every imaginable sort of trellis was used for beans, tomatoes, and peas. Trellises were made of poles, brush, and wire, and in an endless variety of ways. All were most interestingly constructed.

The control of insect pests and plant diseases was rather limited. Some spraying was practiced, however, and many of the larger insects, such as the Colorado potato beetle, were killed by hand. Dusting to repel insects was practiced perhaps more than any other form of pest control. These methods of pest control are not discussed in full, because of lack of space, and also because information on the subject can be procured from any of the State experiment stations, or the United States Department of Agriculture.

PETS AND PESTS.

Aside from the insects, plant diseases, and weeds, which make up the army of pests that infest the growing crops of the truck farmer, the city gardener has problems in regard to chickens, dogs, birds, and other animals which at times become very trying. A child with very little capital, to take the proper precautions against the dangers involved by undertaking too many lines of agriculture on a city lot, finds this especially true. To some extent, the truck farmer is troubled by the same pests; but he usually owns the domestic animals within a dangerous distance, and has ample equipment for keeping them under control. If they are not his the neighbor to whom they do belong likely has a garden of his own, and so the trouble is averted.



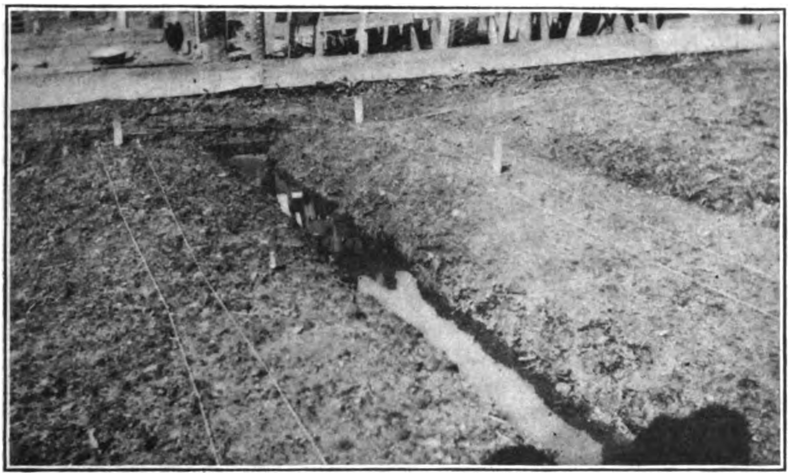
WELL PROTECTED—NOTE THE FENCE.

In addition to the difficulties arising from these different interests, those arising from the number of animals in proportion to plants is very noticeable. In towns and cities, especially in some localities, the dogs, cats, chickens, sparrows, and other animals abound in great numbers. The difficulty is magnified when these animals are kept in check by the inefficient methods of the child or the indifferent attempts of a neighbor who has no garden at all, or has it safely inclosed, and prefers to let his animals run at large. In such a place, the task of raising good vegetables becomes extremely difficult. Especially is this the case, no matter what the enthusiasm of the child, when the neighbor sees a small garden and has the unfortunate opinion that, because the attempts of the child are small and in proportion to his age or size, they are unimportant. As a matter of fact, this situation is not common, but it is regrettable to find it at all.

THE SAME GARDEN AS ON THE OPPOSITE PAGE, LATER IN THE SEASON.

Insects, plant diseases, and weeds are not discussed here because they are so commonly recognized, and because they are mentioned at different places throughout this report. Of the other pests that belong in the class to which the title of this discussion refers, chickens were likely the most numerous, although not always so totally destructive as some other animals. One boy attempting to establish a garden in a back yard alive with the dogs and chickens of the neighborhood decided that the safest way was to turn his chickens loose and use their inclosure for the garden.

Next to chickens, dogs and birds probably did the greatest total damage. Here again, however, their destruction in any one garden was not complete, and so the results to any one owner were not so disastrous. Their damage was largely done in the early part of the season when the plants were small or even before they appeared above the ground. The dogs accomplished their destruction by running through the garden and in many cases were held in check very well by a low fence which diverted their path. The birds, especially the starlings and English sparrows, did their greatest damage by eating the tender leaves of young vegetables. They seemed to be especially fond of lettuce and peas. A string ornamented with strips of white cloth when stretched along the rows of vegetables served to keep them away to some extent as long as the wind was blowing so that the cloth fluttered about. This method, however, was not wholly effective. I have known some adults to go so far as to cover their lettuce with wire netting in order to protect it. The owners of one garden, recognizing the danger from birds, dogs, and small brothers and sisters, without any suggestion from the instructor built a fence of store boxes to guard against dogs and children. Their precautions against the inroads of birds were most elaborate, consisting of a scare crow and several strings of cloths.

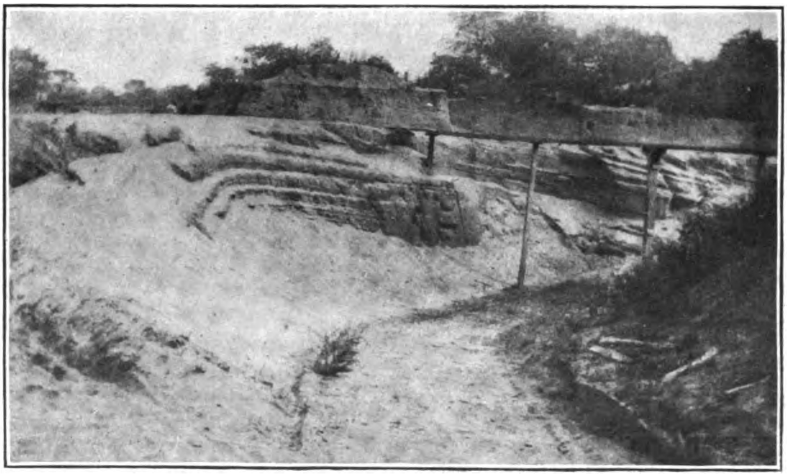


A LOW GARDEN, SUBJECT TO OVERFLOW, RAISED INTO BEDS TO AVOID DAMAGE FROM WATER.

In at least two cases near the outskirts of town, cattle totally destroyed the gardens of members. Other animals which did considerable damage were ducks, rabbits, donkeys, and goats. A colored girl who owned a garden of merit, besides having about 15 ducks and an ever-increasing number of rabbits on a lot 50 by 100 feet to contend with, was blessed with dogs, cats, chickens, and pigeons. They all had their own homes, however, and for the most part behaved very well.

Some difficulty was experienced with children bothering each other's garden. Fortunately this matter was easy to control. There was, indeed, one garden which was completely destroyed in this way, and a few other cases where some injury was done. Most of the damage occurred in sections where gardens were in groups. The garden which was completely destroyed came to a sad end because it was constantly improved with plants taken from adjoining gardens. The boys who owned the surrounding gardens were unable to appreciate such a thrifty method, and expressed themselves definitely. On the whole, however, the boys and girls respected each other's work and treated it accordingly.

Trees were the cause of many partial failures. Their branches cut off the necessary sunlight, and the roots robbed the gardens of their moisture and plant food. When many trees were present the efforts of the children were poorly paid.



SAND-PIT SHOWING CAUSE OF EXTREME DRYNESS IN SOME PARTS OF TOWN.

EXCURSIONS.

The members of the gardening clubs were taken in club groups on automobile trips through the neighboring agricultural region. The citizens of Englewood were very accommodating with their cars, so that it was possible to take a different group on every day from July 5 to July 13, with the exception of Sunday, July 9.

Some of the points of interest visited were well-managed upland truck farms, muck-land vegetable farms, fruit farms, a duck farm, a chicken farm, a dairy farm, a stock farm, seed-testing grounds for a large New York concern, a nursery, and the school gardens of a neighboring town. The following essay will give some idea of the value of these trips. It was hurriedly written some time after the trip by a boy who was making his first trial at gardening. He and his brother were the only ones asked to write reports. The instructor requested these only that he might have some idea of what value the trips were to the children. The writer whose essay is copied here did not mention several of the stops and has confused the order of others. Several doubtful statements are credited to the instructor, and many details are lacking. On the whole, however, it is very satisfactory.

[A boy's narrative of a trip to a farm.]

A GOOD TIME AT VISITING FARMS.

When we started Mr. Smith told us to watch all the farms and what they raised and how it was kept. We started out with four seated in the back; three on the floor and Mr. Smith and the chauffeur in front with a small boy on Mr. Smith's lap.

A LOW GARDEN, SUBJECT TO OVERFLOW, RAISED INTO BEDS TO AVOID DAMAGE FROM WATER.

The first farm we saw was one on Teaneck Road. It had corn, spinach, and tomatoes. Farther on we saw a rhubarb farm. The plants were about 2 yards apart. You could see even paths through the plants. The rows were hoed and clean kept. Mr. Smith told us that only labor and patience could keep the garden so well.

We passed many cornfields. Our first stop was at an old school. When we went out of the auto we noticed an old bell in the tower. The first thing we did was to see who could hit the bell first. We threw for about five minutes and then the bell was hit. Afterwards Mr. Smith took out two bags of peanuts and told us to stay about 20 feet from him. He took one bag and threw the peanuts into the air. Then there was a mix-up, everybody went for the peanuts. The second bag was thrown by the chauffeur. While we were holding up our hands to catch the peanuts Mr. Smith took our picture.

A little further up the road Mr. Smith told us that we were coming to a place where celery, onions, and parsley could only be raised. This place was once a large lake, but the trees and shrubs sucked the water out and it formed a swamp. The farmers came and girdled the trees and dug up the soil, which was very black. The soil, which is called muck, is so rich that only vegetables that need a good soil can be raised there. When we came to the place we saw long rows of celery in a rich, black soil. Some of the rows had boards alongside of them. These boards were to keep the sun from the plants and make the stems white. The rows were about a yard and a half apart. In the middle of each row was a row of smaller plants, so when the larger ones were gone these would take their places. We came to a place where corn was growing among peach trees. This is called intercropping. When the trees get larger the farmer will have to stop planting stuff there. We saw tomatoes and potatoes growing among apple trees.

We went up a tall hill and saw for miles around farms and farms.

Our next stop was at a chicken farm. We did not see many chickens because they were in the fields. The farm had an incubator that contained more than a hundred cells and 48 eggs in each cell. The incubator contains 7,800 eggs. When the young chickens are old enough they are put in small coops. In the center of every coop is a round cover with small pieces of cloth hanging down. This is used as a mother.

A GOOD GARDEN RAISED ABOVE THE LOW GROUND TO THE LEFT, TO AVOID FLOODING. NINE YEARS OLD.

We left this farm and rode around. Then we went to a duck farm. We went into the house where they make the food for the ducks. This is done by machinery. The farm held 18,000 ducks. The coops held ducks of different sizes. All you could hear was "Quack." The incubator room was so hot that we had to run out. Mr. Smith took our picture watching the ducks.

From here we went home. On our way we passed the Tenafly School gardens and the Cleveland School gardens. At the end of the trip we found that we had gone 30 miles in three and one-half hours.

I forgot to tell you about the pole-bean farm we saw by the schoolhouse. In whatever direction you looked was a straight line of poles.

It can plainly be seen that the essay is not a lesson in composition, although it might well be made so. Some confusion is evident. For instance, the boy received a hazy idea of the formation of muck land, probably because of the necessarily hurried way in which it was explained. He did, however, learn that there is such a soil form and that in it grows most of the onions and celery which he eats. Many first-hand impressions of his surroundings which are of value and could not otherwise be adequately taught are evident from the report.

INFORMING THE COMMUNITY.

The publicity work connected with the project was of the utmost importance. This was carried on in a variety of ways. Newspaper articles were used extensively. Gardens were labeled, and the one used for demonstration purposes was marked with a large sign. The produce sold was advertised as being grown by the garden clubs. That from the demonstration garden was sold from house to house with the idea of bringing the work to the notice of as many persons as possible.

VISITING A SEED TESTING GROUND.

On the Fourth of July the local board of trade conducted a parade in which the garden clubs participated. A small float decorated with vegetables from club gardens was drawn by two boys dressed as farmers. This was followed by a procession of other boys wearing overalls and straw hats and girls decked in sunbonnets and aprons.

They all carried hoes, rakes, or banners. For their showing in this event the clubs received a special prize of $25.

Another form of publicity was the distribution of three preliminary reports. These were in typewritten form and were profusely illustrated with photographs. They were distributed in such a way that a great many persons were able to see them. Whenever one group of persons had finished with them, they were returned and sent to another group.

FOLLOW-UP PLANS.

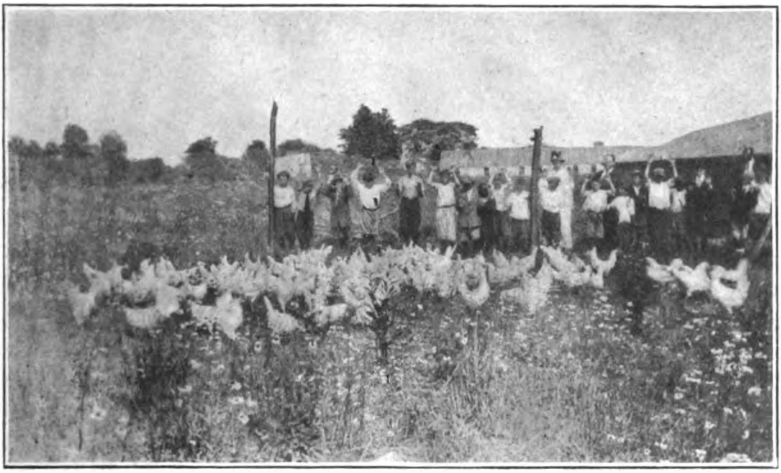
The plans for the season of 1917 were based on the experience gained through the work done during 1916. An extension of the work with home gardens, group gardens, demonstration gardens, and vacant-lot gardens, with slight modifications in systems of management, was provided. Plans for club organizations and competitions were based more definitely on existing school rivalry. New elements of organization and competition were introduced to meet the needs arising with a large number of vacant-lot gardens. Provision was made for some children who do not care for the clubs, but who wish to have supervised gardens. The method of registration included a personal visit to each home. Seed was sold to the pupils of all grades. Pupils below the fifth grade were not included in any of the clubs, but their gardens were visited and small premiums were awarded to the best of them. The record forms to be used by the children and the instructor were revised. Besides continuing on a

NURSERIES ARE INTERESTING PLACES FOR EXCURSIONS.

larger scale the methods of instruction used in 1916, lantern slides for explaining different operations were employed. Additional help for the supervisor was provided for in the new plan.

BLANKS AND CIRCULARS.

The following pages illustrate the blanks and circulars used. The record book used by the child and the teacher's record sheet were slightly revised for use during the season of 1917. The main features are the same, but some changes have been made to meet a few new conditions which have arisen. For instance, the old record provides for no place in which the child could keep a record of money loaned to it for seed and plowing. With large gardens coming into favor, a need for such a form has arisen. Most of the printing was done by the school vocational class.



A SMALL FLOCK OF HENS ON A LARGE POULTRY FARM.

A student's record.—The following completed record is not the best from the standpoint of neatness and literary execution. It was selected because the boys (two brothers) who operated the garden probably learned more about intensive garden practice than any of the other members of the clubs. They also kept their financial record in a creditable manner. How new they were to this work is evidenced by the fact that these two boys spaded under an unused back yard last season to make their first trial at garden work. In some instances the certificates of only one of the boys are shown.

REGISTRATION BLANK OF THE ENGLEWOOD GARDENING CLUB.

Name---------------------------. School --------------------------.
Home-------------------------.
Age-----------------------------. Grade--------------------------.
Have you a back-yard garden spot?------------------------------------
If so, give its dimensions.--
What garden tools have you?--
Have you money for seeds?--
Have you ever worked in a garden?------------------------------------
Do you expect to be in Englewood all summer?-------------------------
If not, how long will you be away?------------------------------------

I hereby approve of my--------------------becoming a member of the Englewood Gardening Club during the summer of 1916.

-------------------------------.
Parent.

A TYPICAL GARDEN EXCURSION.

Teacher's record sheet.—The form of record sheet used by the instructor follows:

School---------------- Grade-------- Name-------------------------------
Age---------- Address---

Seed finances.

	Date.	*Terms.*	*Amount.*
Location of garden--------------------------	------	------	------
Size of garden------------------------------	------	------	------
Experience----------------------------------	------	------	------

RECORD OF VISITS.

Date,----------. Recommendations,-----------------. Grade,---------------.
---------------------. ----------------------. ----------------------.
---------------------. ----------------------. ----------------------.

One sheet was kept for each child. References were made to this sheet by means of an alphabetical list and a list arranged according to the location of the child's home.

Printed circulars.—The following are circulars which were written by the supervisor and distributed among the children. Aside from these, circulars from commercial houses and experiment stations were used.

THE WEED BATTLE.

Now, that your crops are planted and have started to grow, or will start to do so in a short time, you ought to turn your thoughts to the care of the small plants. There are at least four enemies of these little, tender baby plants which you will have to fight if your garden is to be successful. The first of these is the other crop of baby plants in your garden which are known as weeds. There is always a disorderly mob of these savage invaders and unless you meet them with your hands and a good sharp hoe they will overrun your smaller army of well-drilled soldier plants. Yes, the hoe must be sharp, so that your task will be made as easy as possible. With a sharp hoe the weeds can easily be made to tumble in all directions, and the straight ranks of your army will remain as you want them. [To sharpen your hoe use a file and make the edge as much like that of a knife as possible.]

AN OBJECT LESSON IN BACK-YARD CLEANLINESS.

But a hoe can not do the whole trick. After the main army is killed many spies will try to hide in among your plants, dressing themselves in clothes similar to those worn by your men. But you must become well acquainted with your men and not allow the little red weeds to persuade you into thinking that they are beets. These and all the other weeds that lurk as spies in among the rows of vegetables must be met in a hand to hand battle. They must all be done away with.

The sooner you do this after your plants have pushed their heads above the ground, the easier will be your task. Small weeds are usually weak and very easily killed, but large ones are very strong. If you keep the soil between the rows of your garden well hoed and loose, many of the weeds will be killed even before they appear above the surface of the ground.

In fighting this battle, however, you must be careful not to step on your vegetables or allow them to be disturbed in any way. If the hoe should cover them with earth, as it is bound to do unless you hold it firmly and guide it carefully, remove it with your hands, disturbing the plants as little as possible; give them all the chance you can, because civilized babies can not grow well with dirty faces. Continue this battle from time to time, especially after rains, when the soil is nearly dry, and you will be a victorious general.

LOOKING AHEAD.

In doing our gardening work we must constantly be looking into the future so that we can be preparing for what is to come by what we are doing at present. Now is the time to think of what is to be done several weeks or even several months hence and to act in preparation for what is to be done then. One particular thing which must be kept constantly in mind is the public exhibit at which the things we have grown in our gardens will be shown. This exhibit will be held near the middle of September; and unless we keep it in mind from now until that time we will not make the showing which is expected of us. This will be our second public appearance; our first, in the Fourth of July parade, made a big hit, and we have to do even better in our next. But in order to do ourselves justice every one of us must play the game as if we meant it from now until the exhibit is over.

A STOCK FARM WHERE HORSES, SHEEP, HOGS, CATTLE, AND ALL SORTS OF POULTRY ARE KEPT.

In doing our share there are two things at which each of us must work just by way of preparation: First, we must take care of our gardens in the best way we know of, so that our things will grow large and good to look at. We all know what this means—the weeds must be done away with, the injurious insects must be killed, the ground must be kept loose, and the plants must be thinned so that they have plenty of room in which to grow. If there is anything that we do not understand, we can ask Mr. Smith when he calls to see our gardens, or write him a post card addressed to Liberty School.

Second, we must plant vegetables in the spaces left by the removal of the early crops. Already some of the boys and girls have planted late beets, radishes, turnips, beans, and many other vegetables which they will show at the fair. Mr. Smith can also help in choosing late crops for this purpose.

If we are not careful, some of our fellow club members who are already preparing for their part of the exhibit will get ahead of us. None of us dare allow this, because our exhibit at the fair counts one-third toward the final mark for the season upon the basis of which prizes are awarded. Aside from these prizes for the work of the season, there will be premiums offered at the fair for the best exhibits. Now let us all get to work and show the other members of the club as well as the public that we know what we are doing and that our part of the Fourth of July parade was merely a sample of what we stand for.

GARDEN CLUBS OF THE ENGLEWOOD SCHOOLS—CIRCULAR OF INFORMATION.

A Start for Next Year.

Another thing in regard to which we should look ahead is our gardening activities for next year. Now is the time to decide on what we expect to do then. Our plans do not need to be completely made out at this time, but if the best results are to be obtained there are some things which should be done.

First of all we should decide on the size of garden which we expect to cultivate. We have all learned by a year of experience that we can make vegetables grow and have gained some idea of the size of garden that we can successfully operate. That is, we know just about how much land we can prepare for planting, plant, and care for throughout the summer. Most of us can proudly say that we feel that next year we can care for a larger plat of ground than we have now and do it in a better way than we have cared for our gardens this year. Some of us have even gotten into our heads the idea that we can use one of the vacant lots in our neighborhood for a garden similar to the one across from Cleveland School, which is owned by the garden clubs. (If you have not seen this garden, be sure to visit and ask questions of the boys who take care of it.) This is all fine, but whatever we undertake to do next year should be thought of now. The thing to do first is to decide on how large a garden we wish to care for next year.

When this is determined, the next step is to decide where the garden is to be situated, if we have not already its location in mind. The question for each of us is whether it will be in my back yard or whether it will be in a vacant lot near home. Unless our back yards do not afford a place for a garden, or unless that place is not large enough for what we wish to undertake, we should use it in preference to a vacant lot. But if we can not do as we please in our back yards, we should go to the nearest vacant lot which we think would answer our purpose and secure the use of it for next year. Mr. Smith can help you do this.

Now that the size of the garden and its location is decided upon, work should be started at once in getting the ground into shape for next year. This is very important, although it seems like a long time before the land is to be used. The good farmers that we visited on our automobile trips plan on the use of

their lands for five or six years in advance, and so, surely, we should think at least a year ahead and prepare for what is to come then.

If the garden is to be located in the back yard where a garden has been growing this year, work should be started in cleaning away all rubbish just as soon as the different crops are removed. If the season is too far advanced to plant other vegetables in the place of those that are removed, as it will likely be, the ground should be spaded and as much manure as can be procured turned under. When this is accomplished a cover crop (by this is meant a crop of some sort which will keep the rain from washing the garden during the winter) should be planted. For this purpose several things can be used. Rye mixed with winter vetch will likely be the best, although other crops may be used. If we do not know what these things are or where to procure the seed, Mr. Smith can help us.

Those of us who decide to have a garden where there is no garden now should start even earlier to prepare for next year. If our ground is covered with rubbish of any kind, this should be removed at once. Some of us will have but little rubbish, but will find our ground grown over with a heavy crop of grass and weeds. These should not be removed, but should be turned under and used as a green-manure crop, which will make our vegetables grow all the better next year. Along with these all the manure that can be had should be covered over. When this is done a cover crop like the one mentioned above should be planted. In the spring these cover crops can be turned under to act as green-manure crops, which will make a still better garden.

No, it isn't too soon to think it over, after all. When we stop to think, there are lots of things we ought to do if we are going to make the most of our garden next year. What we have discussed here is of the very most importance and applies to every one of us. There are many other things which should be thought of before next spring, and these will be taken up from time to time.

Post-card announcements.—At two different times during the season announcements were made by means of postal cards, which are copied below:

FOURTH OF JULY PARADE.

Meet on Cottage Place at 2 p. m.
BOYS carry rakes and, if possible, wear farmer hats and overalls.
GIRLS carry hoes and, if possible, wear sunbonnets and aprons.

NOTE.—If you have any vegetables that can be used in decorating a float, bring them to Liberty School about 5 p. m. Monday, July 3.

AUTO TRIP.

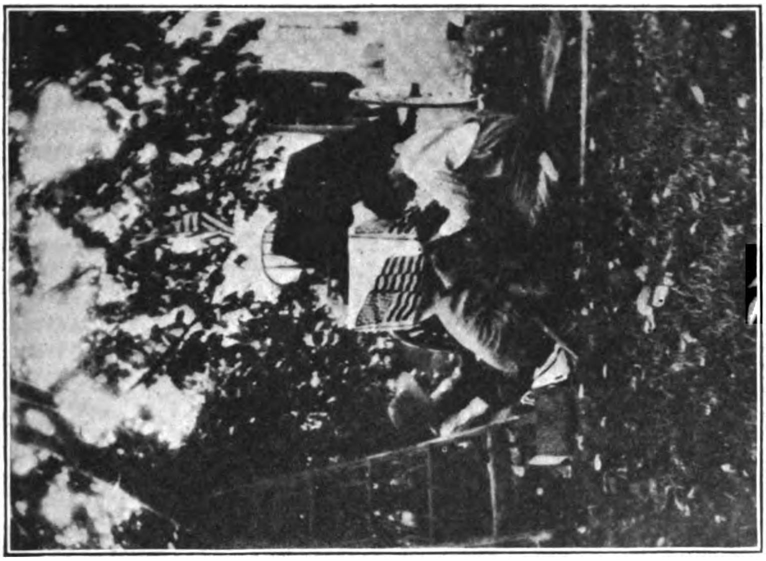
Meet at the school you attended last year at 1 p. m. on Thursday, July 13.

C. O. SMITH.

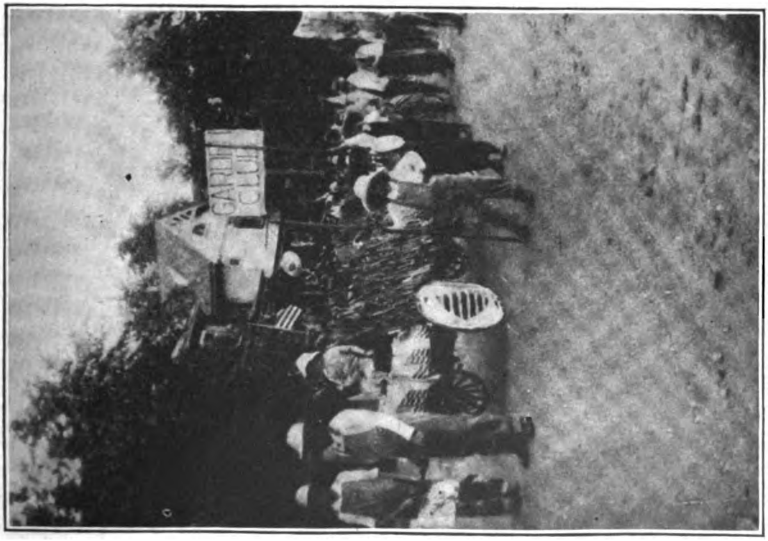
IMPORTANT NOTICE.

On Thursday, Friday, and Saturday, September 14, 15, and 16, the Garden Clubs of the Englewood Schools will hold an exhibit in the windows of Capestro & Co., 42 East Palisade Avenue, and J. D. Chiesa Sons, 10 Dean Street. The products to be exhibited will be collected by means of a wagon early in the morning. If you attended Lincoln School last winter, have your products ready

A PARADE.



Preparation.

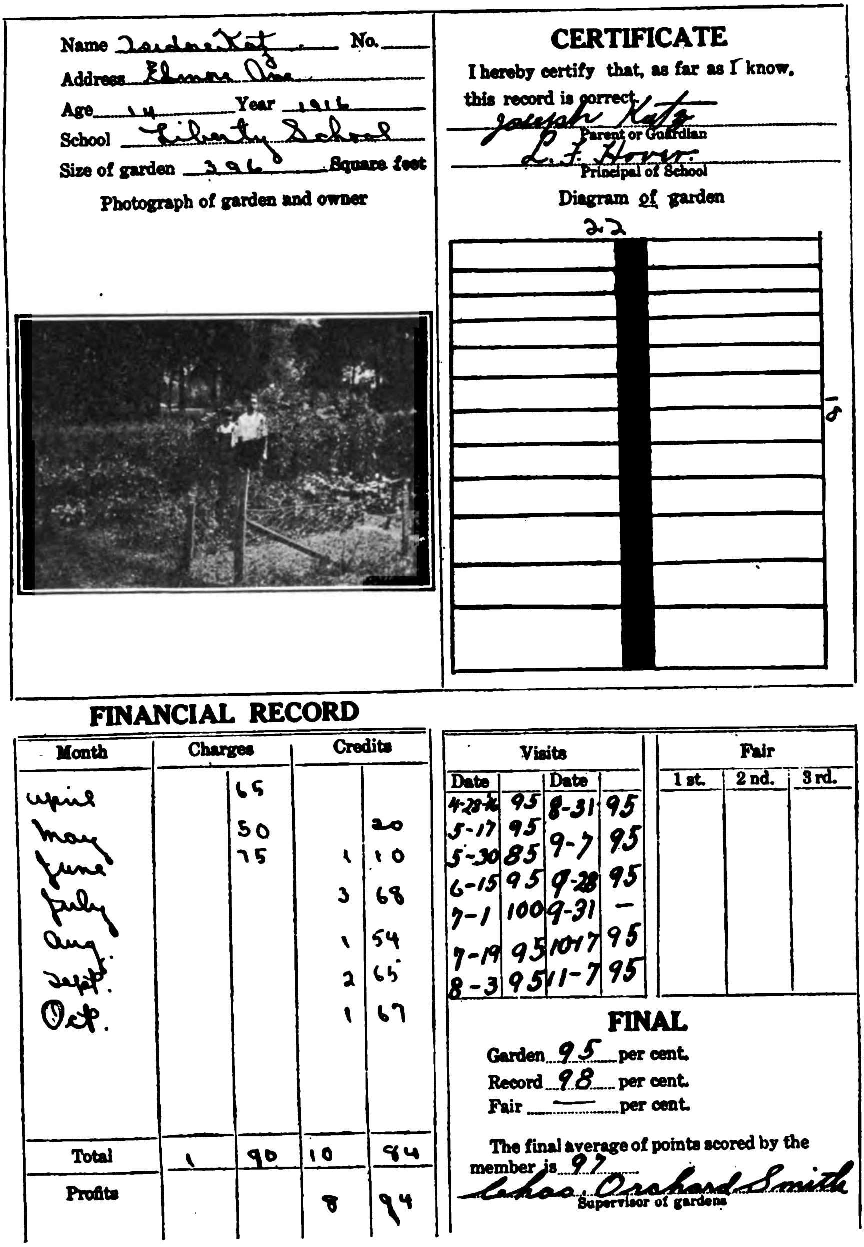


Success.

on Thursday morning. If you attended Liberty School, have them ready Friday morning. If you attended Cleveland School, have them ready Saturday morning. Help to make the exhibit a success by having your vegetables clean and attractive in every way.

CHARLES ORCHARD SMITH.

Both of the times this method was used it proved to be very efficient, because all the children received notice of what was to occur at the same time and at a time when they could not well "forget" the occasion to which they referred.



Name Jordan Katz No.
Address Elmore Ave.
Age 14 Year 1916
School Liberty School
Size of garden 396 Square feet

Photograph of garden and owner

CERTIFICATE

I hereby certify that, as far as I know, this record is correct.

Joseph Katz
Parent or Guardian

L. F. Hover
Principal of School

Diagram of garden

FINANCIAL RECORD

Month	Charges		Credits	
April		65		
May		50		20
June		75	1	10
July			3	68
Aug.			1	54
Sept.			2	65
Oct.			1	67
Total	1	90	10	84
Profits			8	94

Visits				Fair		
Date		Date		1 st.	2 nd.	3 rd.
4-28-16	95	8-31	95			
5-17	95	9-7	95			
5-30	85	9-7	95			
6-15	95	9-28	95			
7-1	100	9-31	—			
7-19	95	10-17	95			
8-3	95	11-7	95			

FINAL

Garden 95 per cent.
Record 98 per cent.
Fair — per cent.

The final average of points scored by the member is 97

Chas. Orchard Smith
Supervisor of gardens

APPENDIX.

A GARDEN NOTE BOOK.

This is to certify that

Isidore Katz

is a member of the

Senior Gardening Club

branch of the

ENGLEWOOD

Gardening Clubs

having been recommended by

Joseph Katz
Parent or guardian

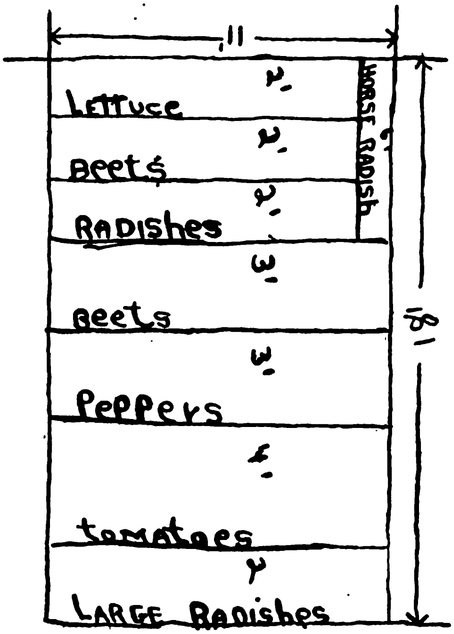
W. W. Staver.
Principal of school

and approved by

Edgar Bloxson
President of branch

Chas. Orchard Smith
Supervisor of gardens

THE WORKING PLAN OF MY GARDEN



½ of Garden

Size 18'x22

Scale ¼" = 1'

Isidore Katz

ITEMIZED ACCOUNT

Charges						Credits			
Date	Item	Time Hrs.	Time Min.	Am't	Totals	Date	Item	Am't	Totals
Apr. 15	forked spade			65		May 31	radishes	15	
May 19	hoe + trowel			30		" "	spinach	05	
" 25	lettuce			10		June 1	radishes	05	
" "	cabbage			05		" 4	"	15	
" "	~~tomatoes~~			05		" 5	"	10	
June 28	seeds			55		" 7	beets	10	
" 29	"			05		" 9	radishes	10	
" 30	"			15		" 12	"	05	
						" 14	beets	05	
						" 15	lettuce	25	
						" "	radishes	10	
						" 17	beets	10	
						" 25	"	05	
						July 1	lettuce	15	
						" "	beets	05	
						" 2	"	10	
						" 2	lettuce	10	
						" 3	"	15	
						" 4	"	05	
						" "		15	
						" 5	"	35	
						" 7	beets	08	
						" 7	lettuce	15	
						" 8	beets	05	
						" 9	lettuce	15	
						" 10	beets	15	
						" "	lettuce	85	
						" 11	"	15	
						" 12	"	30	
						" 13	beets	10	
						" 14	lettuce	05	
						" 15	"	10	
						" 17	beets	05	
									4 58

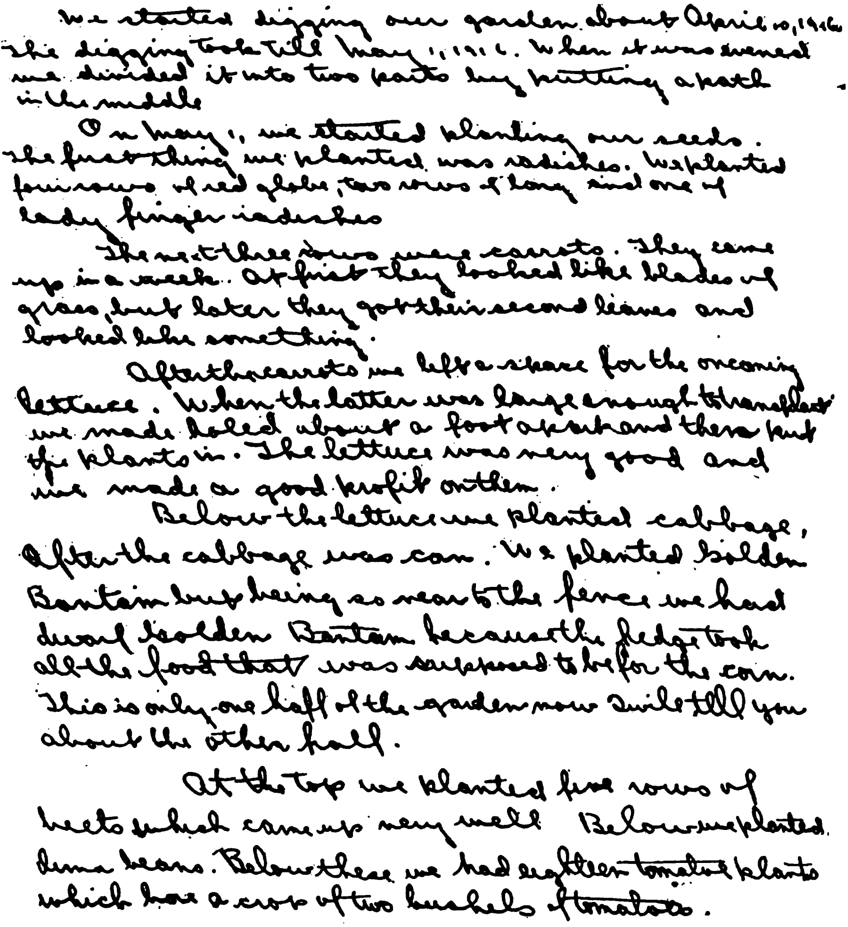
ITEMIZED ACCOUNT

Charges						Credits			
Date	Item	Time Hrs.	Time Min.	Am't	Totals	Date	Item	Am't	Totals
						July 19	beets	05	
						" 29	lettuce	10	
						" 30	beets	15	
						" "	lettuce	10	
						Aug. 1	beets	15	
						" 3		05	
						"	carrots	10	
						" 6	cabbage	10	
						" 7	beets	10	
						" 8	"	10	
						" 8	Radishes	05	
						" 8	cabbage	07	
						" 11	"	07	
						" 13	beets	10	
						" "	radishes	05	
						" 15	cabbage	07	
						" 19	"	07	
						" 21	radishes	10	
						" 22	peas	05	
						" 22	beans	05	
						" 23	radishes	05	
						" 26	cabbage	07	
						" 29	"	15	
						Sept. 1	tomatoes	05	
						" 5	"	15	
						" 5	beets	05	
						" 5	beans	20	
						" 6	tomatoes	05	
						" 8	"	05	
						" 9	beans	40	
						" 9	parsley	10	
						" 9	cabbage	12	
						" 9	tomatoes	05	
						" 10	"	05	
						" 12	"	65	
						" 12	corn	10	
									8 44

ITEMIZED ACCOUNT

Charges					Credits			
Date	Item	Time Hrs. Min.	Am't	Totals	Date	Item	Am't	Totals
					Sept 13	tomatoes	10	
					" 15	"	05	
					" 17	"	05	
					" 18	"	05	
					" 21	"	15	
					" 25	"	05	
					" 26	"	05	
					" 27	"	05	
					" 27	cabbage	05	
					" 28	tomatoes	15	
					" 29	"	25	
					" 30	"	10	
					Oct 1	"	05	
					" 1	beets	05	
					" 3	cabbage	05	
					" 3	tomatoes	05	
					" 4	"	10	
					" 7	"	10	
					" 8	"	05	
					" 8	spinach	05	
					" 9	tomatoes	15	
					" 10	"	05	
					" 11	"	07	
					" 13	"	10	
					" 13	beets	05	
					" 14	tomatoes	15	
					" 19	"	50	
					" 23	beets	10	
								10 84

THE STORY OF MY GARDEN



We started digging our garden about April 10, 1916. The digging took till May 1, 1916. When it was evened we divided it into two parts by putting a path in the middle

On May 1, we started planting our seeds. The first thing we planted was radishes. We planted four rows of red globe, two rows of long and one of lady finger radishes

The next three rows were carrots. They came up in a week. At first they looked like blades of grass, but later they got their second leaves and looked like something.

After the carrots we left a space for the oncoming lettuce. When the latter was large enough to transplant we made holes about a foot apart and then put the plants in. The lettuce was very good and we made a good profit on them.

Below the lettuce we planted cabbage, After the cabbage was corn. We planted Golden Bantam but being so near to the fence we had dwarf Golden Bantam because the hedge took all the food that was supposed to be for the corn. This is only one half of the garden now I will tell you about the other half.

At the top we planted five rows of beets which came up very well. Below we planted lima beans. Below these we had eighteen tomato plants which bore a crop of two bushels of tomatoes.

2

THE STORY OF MY GARDEN

Alongside the fence we planted more corn. Between the corn and beets were cucumbers which died when the first frost came. Below these we planted string beans

We tried intercropping. We planted lettuce between tomatoes, beets, radishes and carrots. We planted cabbage between the tomatoes. After the globe radishes were gone we planted black radishes. These did not come up very well so we took them out and planted spinach.

In place of the lady finger and French radishes we planted peas which came up very good but did not give a large crop. In place of the lettuce we planted radishes and beets. We had three rows of each

The radishes were soon gone but the beets remained. After the beets the planted string beans which came up in three days. We had about 6 rows and got twelve qts. of good sized beans

Below the beans we planted one row of parsley. The parsley was good and grew fast but we could not sell it. After the parsley was planted the beets began to go

When the frost came in October the stuff began to freeze and just the hardy thing remained. Where we had the spinach we made a hotbed. We enjoyed gardening very much and we intend to have a larger garden next year

Isidore R. Katz

DEPARTMENT OF THE INTERIOR
BUREAU OF EDUCATION

BULLETIN, 1917, No. 27

THE TRAINING OF TEACHERS OF MATHEMATICS

FOR

THE SECONDARY SCHOOLS OF THE COUNTRIES REPRESENTED IN THE INTERNATIONAL COMMISSION ON THE TEACHING OF MATHEMATICS

By

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With the Editorial Cooperation of

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INTRODUCTION.

During the deliberations of the International Congress of Mathematicians at Rome in 1908 steps were taken to organize an International Commission on the Teaching of Mathematics, the members of which were to prepare or procure reports on the teaching of mathematics in different countries. Most of these reports were ready for the Cambridge congress in 1912, but since then several more have appeared. At this writing 18 countries have published 178 reports, containing over 12,000 pages. Germany has already issued 50 reports, with a total of 5,393 pages. About a fifth of this space is required by the United States for its 14 reports (the present report being the fifteenth), and about a sixth of the same space by each of the following countries: Austria, with 13 reports; Great Britain, with 34 reports; Switzerland, with 9 reports; and Japan, with 2 volumes. The reports of France cover some 700 pages. Of more modest dimensions are, in order of size, the reports from Belgium, Russia (including Finland), Italy, Sweden, Spain, Netherlands, Hungary, Denmark, Australia, and Roumania (1 report of 16 pages).

From this statement it will be observed that much greater detail is given in the case of some countries than in others. Moreover, even in reports of about the same length different subjects are emphasized. As this bulletin is based very largely upon facts drawn from the reports to the International Commission, the treatment of its sections varies with the extent of data at hand, and lack of uniformity is a necessity. No claim is made for originality of presentation.

For the most part only those schools which are under the immediate direction of the Government have been considered. And even here discussion is limited to the best schools for boys and to the teachers in such schools. As a rule the schools for girls are not as completely organized nor of so high a standard.

It has seemed to me desirable to include in this bulletin, when possible, very brief independent sketches of the educational conditions in the various countries, so that the reader may receive here in connected form condensed but definite accounts of the following phases of educational work in the country under discussion, in so far as they bear on the preparation of teachers of secondary mathematics:[1] (1) The general educational scheme; (2) secondary schools and their relation to that scheme; (3) the mathematics taught in the secondary schools and the pupils to whom it is taught;[1] (4) the inducements (such as salary, pensions, social position) to young men to take up secondary-school teaching as a profession; (5) the universities of the country, the courses of mathematics and allied subjects they offer, and the diplomas or certificates they confer. With this in mind, one may get an intelligent idea both of the preparation of the secondary-school teacher for his duties and of the type and caliber of men who take up such work. An endeavor has been made to picture conditions of the present day. Only occasional brief historical comments have been introduced.

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[1] For greater detail along this line the reader may be referred to Monroe's *Cyclopedia of Education* (5 volumes, New York, 1911-1913). As to mathematical instruction the *Bibliography of the Teaching of Mathematics, 1900-1912*, by D. E. Smith and K. Goldziher (Bu. of Educ., Bul., 1912, No. 29), Washington, Government Printing Office, 1912, contains titles supplementary to the bibliographies in the following pages.

At a meeting of the International Commission on the Teaching of Mathematics held at Paris in April, 1914, the commission decided to study the theoretical and practical preparation of professors of mathematics in the secondary schools of different countries. It was considered that such a work "would constitute in a certain sense the crown of the labors of the commission." Early in 1915 a questionnaire was published[2] in order to acquaint those who might consent to prepare the special reports for different countries with the questions which the commission wished to have them answer. As far as I have been able to learn, only two reports based upon this questionnaire have been published at this writing; these are the brief report (14 pages) by W. Lietzmann, concerning Germany, and the longer report on Belgium by J. Rose. It is hoped that the general report submitted herewith may be considered a worthy contribution to the commission's special inquiry.

At the present time superintendents, inspectors, and principals in many parts of the United States have been forced by public opinion to consider numerous radical changes in methods of secondary-school education. If a high minimum standard of preparation were required on the part of each teacher, and the position of the teacher were made such as to attract in sufficient numbers the best talent in the country, other difficulties would disappear. Most countries considered in this bulletin have far higher standards than we with respect to teachers of mathematics in secondary schools. The degree of this superiority is exhibited throughout the following pages, and some of the chief points are summarized in the last chapter.

In what follows, statements concerning countries now at war refer, for the most part, to ante bellum days.

R. C. A.

December, 1917.

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[1] For fuller account of the work in mathematics see *Curricula in Mathematics, a comparison of courses in the countries represented in the International Commission on th Teaching of Mathematics*, by J. C. Brown (Bu. of Educ., Bul., 1914, No. 45), Washington, 1915.

[2] *L'Enseignement Mathématique*, tome 17, January, 1915, pp. 61-65. See also pp. 129-145.

TRAINING OF TEACHERS OF MATHEMATICS FOR THE SECONDARY SCHOOLS.

I. AUSTRALIA.

Australia is politically divided into five States (New South Wales, Victoria, Queensland, South Australia, Western Australia), which with the island of Tasmania form what has been known since 1901 as the Commonwealth of Australia. At each of the six capitals (Sydney, Melbourne, Brisbane, Adelaide, Perth, and Hobart) there exists a university supported in part by public funds[1] and in part by private endowments and fees paid by students. And while the educational conditions vary greatly in the different States and not a little in the same State, the universities, whatever their status, are the crown of the educational system of which they form a part. The conditions in New South Wales and Victoria, each with a population of more than one and one-half millions and with universities founded well over half a century ago, are greatly superior to those in the enormous State of Western Australia, with its scattered population of less than 300,000 people (in 1911) and a university which has been in operation but a short time.

The peculiarity of Australian education is that the State not only controls, but completely and absolutely supports and regulates the system of public education, without support from or interference by the localities in which the schools may lie. Australian education tends therefore to be centralized, systematic, and homogeneous; but since local interest is naturally fitful, the external equipment of the schools is usually of an inferior character, while the qualifications of the teachers are distinctly superior. Primary education throughout Australia is free, but secondary is not. The State secondary schools are fewer and somewhat less important than those of a semipublic endowed or denominational character.

The organization of secondary education in Australia is passing through a period of active development. But until very recently the chief influence upon the work of the secondary schools has been exerted by the universities, not only through their requirements at matriculation, but also through a system of public examinations taken by pupils of the schools whether they proposed to enter the universities or not. These examinations are similar to the Cambridge and Oxford local examinations. The machinery in connection with them has differed from State to State. Since 1912 they are gradually being displaced by a much more satisfactory system of State intermediate and leaving certificates. The requirements for these examinations and certificates give a fair idea of the ground the teacher must cover in his instruction. For the States in order these requirements are:

---

[1] "The universities, though not State universities in the usual sense of the term, are in most cases largely supported by the State. In some instances the proportion of their revenues derived from the treasury is so large that, except for the freedom of their administration, it would be difficult to distinguish them from State institutions."

JUNIOR AND SENIOR EXAMINATIONS.

UNIVERSITY OF SYDNEY.

Till very recently the junior examination was held in June of each year. Candidates averaged 15 years of age. The examination was intended to cover the first two or three years' work of the secondary school. Every student matriculated at the university had to pass the mathematical papers of this or an equivalent examination. Almost all of those taking mathematical classes in their university course also passed the senior examination in mathematics before entrance. The senior examination was usually taken from one and a half to two and a half years after the junior; additional papers or separate questions were set for honor candidates.

In New South Wales the above junior and senior examinations are now replaced by the system of State intermediate and leaving certificates. The former is awarded after the successful completion of two years' work in the high school. The courses of study in the mathematical subjects are, in outline, as follows:

Arithmetic: This forms a part of the first and second years' work for all pupils. It includes mensuration, the plane figures named in the syllabus being the rectangle, triangle, parallelogram, quadrilateral, and circle. The solids are the rectangular box, prism, pyramid, cylinder, cone, and sphere. The simple numerical trigonometry of the right-angled triangle is also introduced. This is not taken in the arithmetic course till after a simple geometric treatment has made possible a satisfactory discussion of the points involved.

Algebra: The work in algebra of these two years goes up to simple case of simultaneous quadratics. The variation and change of sign of the expressions $ax+b$ and ax^2+bx+c are studied graphically and algebraically.

Geometry: This course covers the subject matter of Euclid's Elements, Books I–III, with some freedom from his methods and sequence. Prop. 4, Book I, is accepted as an axiom. Preliminary practical work in geometry will in most cases have been done before entrance upon the course of the secondary school.

The third and fourth years' work in the high schools is divided into pass and honor sections. Practically all pupils have to do some mathematical work in these two years, but only those who have shown special aptitude for this study attempt the full course. Indeed, some take only part of the pass course, but all who desire leaving certificates to count as equivalent to the matriculation examination have to satisfy the examiners in one of the two pass mathematical papers, and thus have to reach a certain standard in algebra, geometry, and trigonometry. There are three higher papers set in mathematics—one devoted to geometry and trigonometry; another to algebra, coordinate geometry, and the elements of the differential calculus; and the third to mechanics.

The nature of the work in mathematics tested at the leaving certificate examination is as follows:

Algebra: The pass work in algebra distributed over the third and fourth years includes what may be described as "up to the binomial theorem, with a positive integral index." Interest and annuities are introduced after logarithms, and graphical illustrations of maxima and minima, etc., are given. The arithmetic course is supposed to have been completed in the first two years.

The additional work for honors includes: Convergence of series; the binomial theorem with fractional or negative index; the exponential and the logarithmic series.

It comprises a course in coordinate geometry of the straight line and circle, and a short introduction to the differential calculus. Only differentiation of powers of x and simple algebraic expressions need be attempted; the results are applied to the equations of tangents in coordinate geometry, to velocity and acceleration, and to the determination of important areas, surfaces, and volumes.

Geometry: The pass work completes the usual elementary course in geometry, without solid geometry. The additional work for honors is as follows: Modern geometry—including transversals; nine point circle; harmonic ranges and pencils; pole and polar; similitude; and inversion. Solid geometry—including the substance of Euclid's Elements, Book XI, 1–21, together with theorems relating to the surfaces and volumes of the simpler solid bodies. Geometric conics—including the more important properties of the parabola and the ellipse.

Trigonometry: The pass work takes the pupils up to the solution of triangles. The honors work, in addition, includes a fuller treatment of the preceding, with circular measure, De Moivre's theorem, and certain types of series.

Mechanics: This subject is not divided into pass and honors. It comes as one of the higher papers in mathematics. It is intended to be preceded and accompanied by experimental work. Indeed, in many schools the course is under the direction of the science master. It includes the usual elementary work in statics and dynamics, with elementary hydrostatics and atmospheric pressure.

UNIVERSITY OF MELBOURNE.

Here the scheme of public examinations includes the junior and the senior examinations. The usual age for the junior is about 16 and for the senior about 18.

At entrance to the university a certain amount of mathematics is required for all the faculties, except for those of law and music. In *arts*—arithmetic, algebra and geometry; in *engineering*—arithmetic, algebra, geometry, and trigonometry; in *science*—arithmetic, algebra, and geometry. The scope of the examinations in these subjects is very similar to that indicated above in connection with the intermediate and leaving certificates.

UNIVERSITY OF ADELAIDE.

Among the public examinations in this university are the junior and senior and a higher examination. These examinations cover much the same ground as the junior and senior examinations in New South Wales and Victoria, but the programs (in mathematics at least) do not include the work prescribed for honors. The requirements at entrance to the different faculties are as follows: *Science and medicine*—the senior examination must be passed in arithmetic, algebra, and geometry; *engineering*—the senior examination must be passed in arithmetic and algebra, geometry, and trigonometry.

Up to 1913 some of the schools of Western Australia sent up their pupils to the public examinations of the University of Adelaide, but with the foundation of the University of Western Australia this practice has been discontinued.

UNIVERSITY OF QUEENSLAND.

Until the year 1910 the secondary schools of Queensland usually sent up their pupils for the public examinations of the University of Sydney. The public examination system has now been adopted by the new University of Queensland. The mathematical programs for its junior and senior examinations are practically the same as those in Sydney.

UNIVERSITY OF TASMANIA.

The scheme of public examinations includes a junior and senior examination somewhat like the corresponding examinations in Sydney. The scope of these examinations as regards mathematics has, however, been much narrower. A beginning of better things was made with the foundation of two State secondary schools in 1913. The education department proposes, with the assistance of departmental officers, secondary school teachers, and representatives of the university, to frame a four-year curriculum on lines similar to that adopted in New South Wales, and it hopes to get the university authorities to recognize it.

TRAINING OF TEACHERS.

For teachers in the secondary schools—public or private—a university degree has been in the past, and still remains, an almost indispensable qualification. It is in all cases recognized to be desirable, and in some cases insisted upon by the regulations for registration, that special training in the theory and practice of education be included in addition to the work of the regular university curriculum in arts or science. Further, in at least one State a fair number of traveling scholarships enable the best of the candidates for the teaching profession to enjoy a year or more in Europe or America at the chief institutions for the training of teachers, or in special study at the universities.

It remains to describe the work of the teachers' colleges and to give indications of the courses in mathematics at the universities which have been available for the future secondary school teachers. For this purpose it will be convenient to take the different States separately.

NEW SOUTH WALES.

The Teachers' Training College in Sydney was founded in 1906[1] for the training of State school teachers and others who might desire to take advantage of the courses on instruction given therein. The college provides a variety of courses of training, varying in length from six months to four years.[2] The ordinary college course is the two years' course,[3] which qualifies for teaching in the classes of the primary school. For entrance to the regular college course the leaving certificate or its equivalent is soon to be required. For the present it has been found desirable to admit students having received only the intermediate certificate granted by the high school at the end of two years of study.

The regular students of the college who have reached the standard of the matriculation examination in the faculties of arts or science are encouraged to attend the university classes, instead of those at the college, in the subjects of their course. They are admitted to these classes without fees. Those who do satisfactory work at the

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[1] The erection of a new building for the college was commenced in 1914 on land provided by the University of Sydney. When completed it was planned that it should provide training for private secondary and primary schools, as well as for State service.

[2] The minimum age of admission to the college is 17 years. The fees for training courses are as follows: Six months, 7£ 10s.; one, two, three, or four year courses, 15£ per annum for those taking both general and professional subjects; fees are returned to those who enter the service of the Department of Education.

[3] Every student of the first year must take the following mathematical classes:

Arithmetic.—There is no set academic work in arithmetic; one hour per week of each term is given to the method of teaching the subject. Amongst others the following topics are discussed: Brief historical review; reasons for teaching arithmetic present tendencies; real applied problem movement; nature and source of problems; use and limitation of objective material; place of oral and written work in the various classes; topical-spiral treatment, various methods of teaching sections of arithmetic, the beginnings of number work; plan and purpose of mechanical work; teaching of processes; the primary school curriculum.

Geometry.—Brief historical sketch of the development of geometry; Egyptian geometry; Greek geometry; the work of Euclid; the reform movement in the teaching of geometry; the present attitude toward the subject; the nature and place of definition, axiom, postulate, proof; experimental and demonstrational geometry; the relation of solid and plane geometry; congruence, similarity, and homology of figures and their applications; extension to trigonometry.

A short course in solid geometry.

Algebra.—Those topics in elementary algebra which require special treatment in class teaching are discussed, including the following: Relation of algebra to arithmetic; literal arithmetic, formulae from arithmetic and mensuration; notion of a negative; operations involving negatives; the equation; solution of problems by means of equations; factors and their applications; indices, logarithms, calculations, with use of logarithm tables and slide rule; irrationals, numerical evaluations, using tables; ratio, proportion, variation, and their application; notion of a function; graphical representation of the variations of a function; discussion of roots of equations, maximum and minimum values from graphs.

Trigonometry.—The purpose of the course is to investigate those cases of the solution of triangles which are used to obtain heights and distances.

Notion of an angle; instruments in common use for measuring angles; sine, cosine, and tangent of acute angles; reading sine and tangent tables; solution of right-angled triangles; use of four-figure tables; extenuniversity in their first two years have their college scholarships continued, so as to enable them to graduate in arts or science. The staffs of the high schools are chiefly recruited from students of the Teachers' College who have graduated at the university in this way.

In addition to these courses, a one-year course is provided at the college for graduates of the university who have not entered upon the course of training in the regular way. This class is exclusively professional and qualifies for the second-class certificate of the Department of Education.

Further, special provision is made for training of teachers for secondary schools. Graduate students of the college take the courses required for the university diplomas in education or similar courses at the college itself. Candidates for this diploma must have graduated in arts or science before admission to the course. The special work for the diploma can be completed in one year by those who are able to devote their whole time to it. The requirements of the course are as follows:

Lecture work:
- I. A first course in philosophy of education.
- II. A higher course in education.
- III. A course in principles of teaching.
- IV. A course in school hygiene.

Practice work:
- I. Continuous practice—from 8–10 hours per week.
- II. Observation and discussion of lessons—from 2–4 hours per week.

In the course on principles of teaching, some instruction in the methods of teaching mathematics is given by one of the lecturers in mathematics.

Practice schools for primary and secondary work are associated with the college. The principal is also professor of education at the

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sion of definitions of sine, cosine, and tangent to angles between 90° and 180°; relations between sides and angles of a triangle; area of triangle; notion of triangulation and application to simple surveys; heights and distances in more than one plane.

The mathematical work in the second year is optional. The program for the class includes algebra, trigonometry, coordinate geometry, mechanics, infinitesimal calculus, and history and method of elementary and secondary school mathematics.

Throughout the academic work the professional aspect is kept prominently in view.

Algebra.—Ratio, proportion, variation, the progressions (arithmetic, geometric, harmonic), permutations and combinations, mathematical induction, binomial theorem.

Trigonometry.—Continuation of first-year course, including angles of any magnitude, $\sin (A \pm B)$, $\cos (A \pm B)$, $\tan (A \pm B)$, $\sin A \pm \sin B$, $\cos A \pm \cos B$. Relations between sides and angles of a triangle, solution of triangles, heights and distances, circular measure, De Moivre's theorem, simple trigonometric series.

Infinitesimal calculus.—A course on the processes and applications of the differential and integral calculus. Graphical methods are freely used where advantageous. The course is designed particularly to complete the work in geometry, mechanics, and trigonometry.

Mechanics.—The aim of the course is to teach the fundamental mechanical principles. Simple courses of experiments illustrating the following: Composition and resolution of forces; principle of levers; pulleys, inclined plane; friction; motion of falling bodies; circular motion; principle of Archimedes; hydraulic press and pump; atmospheric pressure; easy practical calculations within this range.

Reading.—Students do directed reading of mathematical works in the college library, as well as in the following textbooks: J. W. A. Young, *Teaching of Mathematics in the Elementary and the Secondary Schools*; Fink, *History of Mathematics*, translated by Beman and Smith.

university, and the work of the college is carried on in cooperation with the university, so far as possible.

Let us now take note of the university mathematical courses, which are open to our prospective high-school teachers in connection with his course. There are three classes—mathematics I, II, and III. Each is divided into three sections—class A, class B, and class C. Candidates for the degree of B. A. or B. Sc. with honors attend the honors section (class A) in each year, but it is possible to reach the lowest grade of honors by specially good work in the second section (class B) in the three years. The programs for class A are as follows:

Mathematics I (first year): Algebra, geometry, trigonometry, statics and dynamics, analytic geometry of two dimensions, and the elements of the calculus. Those who enter it are expected to have previously completed the mathematical work required for honors in the senior public examination or an equivalent course. The class is attended by students in arts, science, and engineering.

Mathematics II (second year): The infinitesimal calculus, differential equations, spherical trigonometry, analytic statics, dynamics of a particle, and elementary rigid dynamics. The class is attended by the best students of Mathematics I when they proceed to their second year.

Mathematics III (third year): Analytic geometry of three dimensions, rigid dynamics, higher analysis, and some applied mathematical subject, e. g., hydrodynamics, sound, the theory of electricity and magnetism.

In addition to these courses a two-year course has recently been instituted in the mathematics of insurance, chiefly for actuarial students and others who desire instruction in the mathematics of statistics.

Since 1908 the teacher's promotion depends not only on the classification of his school as determined by average attendance, but also on the improvement of his qualifications. To qualify for a higher grade the teacher must pass a series of examinations as well as show "the requisite degree of proficiency in practical work."

Salaries paid to high-school teachers.

Teachers.	Men.	Women.
Principal of—		
Boys' or girls' school	£400-£600	£300-£450
Mixed school	350- 450	....
"Master" or "mistress" of a department	300- 400	200- 300
"Assistant"	200- 300	180- 250
"Junior staff"	168- 228	144- 180

VICTORIA.

Those preparing to become teachers in the secondary schools of Victoria receive almost all of their instruction at the university. Under regulations now in force, every teacher in a secondary school must possess the university diploma in education or an equivalent qualification. All candidates for that diploma must have passed through at least two years of some degree course, and must have a final year of special work in education. As a matter of fact, many of those working for the diploma take their B. A. or B. Sc. degree before entering upon the special course in education for the diploma.

Of the various groups of students entering the Teachers' College at Melbourne only those taking the three years' course for the secondary certificate are of interest to us. Those accepted for this class must have passed the senior public examination or an equivalent examination. The number admitted to the class is limited to 15 each year. Their course of training is the same as that for the diploma of education at the university, with the addition of some special subjects. The first two years are spent in regular attendance upon university classes in arts or science. Having passed the first and second years' examinations in arts and science, they are then admitted to the special university courses in education for the diploma. These courses include lectures on the theory of education, with special reference to the methods of teaching the various subjects. The course in mathematics contains the following:

(i) Special methods of teaching arithmetic, algebra, geometry, and trigonometry.
(ii) A short history of elementary mathematics.
(iii) General considerations on the teaching of mathematics.

Students are required further to teach 120 hours under supervision; to attend lessons given by members of the college staff; and also to criticize lessons. Part of this practice is obtained in the primary schools, and part in the special secondary practicing school attached to the Teachers' College, and in other schools.

There are about 50 to 60 regular students of the college each year preparing for this diploma, and in addition about the same number of university students are qualifying for it, in order that they may be enabled to take up work in the secondary schools outside the control of the Department of Education.

The authorities of the college are entitled to nominate six of those who distinguish themselves in this course for a further year's work.

At the University of Melbourne courses in pure and applied mathematics are offered for each of the three years.

Pure I. Pass—The course is analytical. It deals with the elementary algebraic, trigonometric, exponential, logarithmic, and hyperbolic functions, with their graphs and derivatives; maxima and minima; elementary processes of integration; the definite integral as the limit of a sum. *Honors*—Algebra, trigonometry, elementary analytic geometry of two dimensions, and elementary calculus.

Applied I. Pass—Elementary statics and dynamics, with hydrostatics. *Honors*—A fuller treatment of the subjects of the pass class with the elements of vector algebra.

Pure II. Pass—In this course further work is done in plane analytic geometry and calculus. *Honors*—This class continues the work of I (honors) in plane analytic geometry and the calculus, and it begins analytic geometry of three dimensions.

Applied II. Pass—Elementary analytic statics and dynamics, with hydrostatics. *Honors*—Analytic statics, dynamics of a particle, elementary rigid dynamics, and hydrostatics.

Pure III. *Pass*—Solid geometry and the calculus, with differential equations. *Honors*—In addition to the subjects for II (honors): The functions of a complex variable, Fourier's series and integrals, differential equations and calculus of variations.

Applied III. *Pass*—Analytic statics and dynamics, the elements of the theories of potential, hydrodynamics, elasticity, and electricity. *Honors*—More advanced work in these subjects.

SOUTH AUSTRALIA.

The following is an outline of the course of training for teachers in the schools of South Australia under the department of education in Adelaide:

1. At the age of 14 the future teachers enter the Adelaide high school. They remain there for three years and receive a general education. At the end of this period the majority will have passed the senior public examination in the University of Adelaide; practically every student passes in arithmetic and algebra; a large number pass also in geometry and in trigonometry.

2. The students in training now become "junior teachers," and spend one to two years in primary schools, devoting practically all their time to their teaching work.

3. Thereafter they enter the Teachers' Training College. Here the students attend university classes in various subjects, a certain amount of freedom of selection being permitted. About 20 per cent take up what is called first-year pure mathematics, an elementary class at about the standard of the higher public examination in algebra, geometry, and trigonometry.

The students also attend several training college lectures, among these being a course in the principles of teaching. This course deals with the methods of teaching the primary school subjects; about 16 out of a total of 80 hours are devoted to arithmetic. They also spend one morning per week at actual teaching in the primary schools.

Those who have shown special ability both as students and teachers are permitted to remain a second year, or even a third year, at the university. These students invariably take up a certain amount of mathematics, usually attending second-year pure mathematics, as they will in most cases have already taken the first class. Some also take the elementary applied mathematics class. It is not uncommon for mathematics, physics, and chemistry to form the bulk of their work.

Such students have practice as before; also weekly discussions on the methods of teaching. Five of these discussions out of a total of twenty-five deal with elementary mathematics. The majority of these students become high-school teachers.

The mathematical courses offered in the University of Adelaide are very similar to those of the universities of Sydney and Melbourne. Horace Lamb and W. H. Bragg were for many years professors in this university.

QUEENSLAND.

Queensland does not yet possess any special college for the training of teachers. In the "grammar schools" the staff consists principally of university graduates. The high schools also aim at making a university degree an almost indispensable qualification for their teachers.

The University of Queensland, which was founded at Brisbane in 1909 and formally opened in 1911, has an important sphere of influence, and the same general scheme of mathematical instruction as in other States of the Commonwealth is in vogue.

TASMANIA.

Under the scheme for training of teachers which is being introduced in Tasmania candidates pass the senior public examination and matriculate at the university. The next year is spent in teaching in selected schools. Thereafter they enter the training college at Hobart, the minimum age at entrance being 18 years. They attend university classes for two or three years. All receive professional training at the college.

Mathematical courses at the university are similar to those already described.

WESTERN AUSTRALIA.

The organization here being in its infancy, there is nothing of exceptional interest to record.

The universities of Australia are staffed by British professors, and thus the mathematical work of the country is fashioned in conformity with much the same ideals as those held in the motherland.

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In the above sketch I have many times quoted verbatim from Prof. Carslaw's most readable report

J. B. TRIVETT, *The Official Year-Book of New South Wales for 1915.* Sydney, W. A. Gulick, 1917.

"Education," pp. 213-274.

Rept. of U. S. Commis. Educ., 1915-16, Vol. 1, Washington, 1916.

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Two other recent publications contain considerable information about the universities:

(1) *Universities in the Overseas Dominions*, Board of Education, Special Reports on Educational Subjects, vol. 25, London, 1912, pp. 116-171, 196-198, 238-269;

(2) *Congress of the Universities of the British Empire, 1912, Report of the Proceedings*, London, 1912; also the *Year Book*, 1914.

II. AUSTRIA.

Austria is nearly 116,000 square miles in extent, and its population totals in the vicinity of 29,000,000. Of these, about 10,000,000 are Germans; nearly 6,500,000 are Bohemians, Moravians, and Slovaks; at least 5,000,000 are Poles; and some 3,500,000 are Ruthenians.

The minister of public instruction is at the head of the Austrian educational system. He has inspectors of secondary schools in each of the 14 Provinces of the Empire and certain matters of administration are assigned to local boards. Church and private schools are subject to the same regulations as those of the State.

SECONDARY SCHOOLS.

Before 1908 there were three general types of middle or secondary schools: (1) The Gymnasium, (2) the Realschule, and (3) the four-year Realgymnasium, the courses of study in all of which were based upon four years of work in the primary schools. The first two of these types are still the most prominent. The normal age of the pupil commencing secondary education is about 10 years.

The complete Gymnasium provides for a course of eight years' study, divided into two parts of four years each. The first part is referred to as the Untergymnasium; the latter as the Obergymnasium. The course of study is characterized by the great emphasis laid on instruction in Latin, Greek, and German. In passing from one class to another the pupils undergo very searching examination. This is characteristic of all the Austrian secondary schools.

The seven years' course of the Realschule consists of two cycles of three and four years each, corresponding to programs of the Unterrealschule and Oberrealschule. Here the emphasis is laid on modern languages (Latin and Greek are not taught at all), mathematics, physics, chemistry, etc.; that is, on those subjects which are designed to impart technical knowledge and afford suitable training to those intending to follow industrial pursuits.

As a result of a ministerial decree in 1908, the establishment of Realgymnasien and Reform-realgymnasien, each with an eight-year course, was also authorized. But, in what follows, the Gymnasium and Realschule[1] only will be treated as representative of Austria's best secondary schools.

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[1] In 1915-16 there were 336 Gymnasien, of various forms, for boys and 148 Realschulen.

The number of hours per week devoted to class work in mathematics (M.), geometric drawing, and descriptive geometry (D. G.), in these types of schools, is exhibited in the following table:

		I	II	III	IV	V	VI	VII	VIII	Total.
Gymnasium	M.	3	3	3	3	3	3	3	2	23
	D. G.	3	3	2	2	0	0	0	0	10
Realschule	M.	3	3	3	4	4	3½	5	0	25½
	D. G.	0	2	2	3	3	3	2	0	15

The total number of hours in these subjects represents about 14.7 per cent of all class periods in the Gymnasium and about 16.5 per cent of those in the Realschule.

In classes I–VIII of the Gymnasium instruction is given, according to the program of 1909, in arithmetic, algebra, plane and solid geometry, plane trigonometry, plane analytic geometry, and elements of calculus.

To give a definite idea of the nature of the contents of these courses a few selections from the program may be made:

Class V: Extension and completion of arithmetic and algebraic studies of the previous class. Continued practice in solution of equations of the first degree arising "from the manifold spheres of thought in which they may be applied." Practice in powers and roots by straightforward examples. *Solid geometry.*—Oblique projections[1] of the simplest bodies (also of crystalline forms). Plan and elevation of simple objects by observation and common sense. Conceptions and laws concerning the mutual relations of straight lines and planes; limited to the fundamental and typical propositions and proofs with constant appeal to observation and intuition. Properties and calculations for surface and volume of prisms (cylinders), pyramids (cones), the sphere, and their sections and portions when in section. Euler's theorem ($S+F=E+2$); regular polyhedra. *Obergymnasium—Class VI: Trigonometry.*—The trigonometric ratios, their geometric representation, especially for the purpose of giving a firm grasp of the characteristics and relations of these functions. Solution of triangles. Repeated comparison of trigonometric propositions and methods with those of plane and solid geometry. Varied applications of trigonometry to problems in surveying, geography, astronomy, etc., the data where possible to be obtained from direct (even though rough) measurements by the pupil. *Class VII: Algebra.*—Arithmetic progressions (of the first order),[2] geometric progressions. Application of the last especially to compound interest. Permutations and combinations in simplest cases. Binomial theorem for positive integral exponent. Theory of probabilities. *Analytic geometry.*—As a continuation of the graphic representation of single functions previously given, further use is made of the analytic method in dealing with lines of the first and second degree with reference, when occasion offers, to the geometric treatment of the same figures and their relations. Representation of direction coefficients (chiefly those of the curves dealt with in class) by means of derivatives. Simple problems of differentiation in connection with problems in mathematics and physics. Approximate solution of algebraic equations (and of the simplest transcendental equations which occur) by graphic methods. In *Class VIII* the two hours a week are given up to a comprehensive recapitulation of the whole range of school mathematics, especially equations, series, solid geometry, trigonometry, and analytic geometry. Broader and deeper treatment of particular parts of the subject. Applications to the various subjects of the curriculum and to practical life in place of merely formal exercises. Retrospective and prospective consideration from historical and philosophical points of view.

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[1] Drawings of solid bodies to show several faces, etc., not in true perspective, but free-hand or constructed according to very simple rules. Cf. A. Höfler, *Didaktik des mathematischen Unterrichts*, p. 207.

[2] Ordinary arithmetic progressions are said to be of the first order. Series such as $1^2+2^2+3^2+ \ldots$, $1^3+2^3+3^3+ \ldots$, are called A. P. of higher orders.

For the Realschule the work is very similar. There is the same effort to correlate mathematics with other branches of instruction on which it happens to bear and with practical applications in actual life.

Though searching examinations of "orientation" and "classification" have been the portion of students of the Gymnasium and Realschule each year, the final examinations (Maturitätsprüfungen) leading to the certificate of maturity were formerly often much feared.[1] Some amelioration with respect to the extent of detail here required was made imperative by the decree of 1908.[1]

The main object of these examinations is to determine whether or not the maturity, general efficiency, and development of intelligence on the part of the candidate is sufficient to allow him to take up studies in the universities or higher technical schools. Whilst the examinations for "classification" establish in some measure the rating of a pupil's acquisition with reference to a certain part of the program taught, the "Maturitätsprüfung," on the other hand, embraces the whole range of knowledge acquired by the pupil in the Gymnasium or Realschule.

The examination consists of two parts, a written and an oral. The former includes questions on the required languages, on mathematics, on exercises in descriptive geometry, and tests in facility with freehand drawing. The oral examination is on geography, history, mathematics, descriptive geometry, physics, chemistry, and natural history.

The examination commission pronounces its verdict after consideration of all the written and oral examinations as well as of the grades received by the candidate in tests during the last year of his course. When a candidate fails he may present himself a second time at the end of a semester or of a year, but he may not repeat the examination more than twice.

UNIVERSITIES AND PREPARATION OF SECONDARY SCHOOL TEACHERS.

There are eight State universities in Austria. The largest is the University of Vienna (German), with over 10,000 students.[2] The oldest, dating back to the fourteenth century, is the German-Bohemian University of Prague. There are three other German universities, at Gratz, Innsbruck, and Czernowitz. The Polish universities are at Krakow and Lemberg.

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[1] Cf. F. Wallentin, *Maturitätsfragen aus der Mathematik. Zum Gebrauche für die obersten Klassen der Gymnasien und Realschulen zusammengestellt*. 10. Auflage. Wien, C. Geroldssohn, 1912. 8+197 pp. *Auflösungen*, 5. Auflage, 1906. 8+221 pp.

[2] In the summer of 1916 this number was reduced to 3,472

Instruction in the universities is imparted by means of: I, general courses; II, special courses; and III, exercises in proseminary and seminary.

I. The general courses are organized with a double aim: (1) To furnish fundamental theoretical knowledge to those studying mathematics in a purely scientific spirit and proposing to terminate their studies with the doctorate; (2) to prepare students destined for secondary-school teachers. Especially in view of this second aim are the general courses usually organized in cycles of three or four years, and each year a course for beginners is arranged that they may be taught differential and integral calculus as soon as possible, since it is necessary for the study of theoretical physics.

During the five years 1905–6 to 1909–10 professors at (1) the University of Vienna and (2) the German section of the University of Prague gave the following general courses:

(1) Differential and integral calculus, 5 hours weekly during 2 semesters; theory of numbers, 5 hours during 2 semesters; theory of differential equations, 5 hours during 2 semesters; calculus of probabilities, 3 hours; definite integrals and calculus of variations, 5 hours during a semester; theory of linear differential equations, 5 hours; elliptic functions, 5 hours; theory of functions, 5 hours during 2 semesters; algebra, 5 hours during 2 semesters; analytic geometry, 4 hours during 2 semesters; theory of invariants with geometric applications, 2 hours; algebraic curves, 2 hours; curves and surfaces of the third order, 2 hours; synthetic geometry, 4 hours during 2 semesters; differential geometry, 2 hours during 2 semesters; line geometry, 2 hours; continuous groups, 2 hours; noneuclidean geometry, 2 hours; insurance mathematics, 4–6 hours during 2 semesters; mathematical statistics, 3 hours; sickness and accident insurance, 2 hours.

(2) Applications of infinitesimal calculus to geometry, 3–4 hours; theory of invariants, 2 hours; differential and integral calculus, 4–5 hours during 2 semesters; systems of algebraic equations, 1 hour; differential equations, 5 hours; introduction to calculus of variations, 1 hour; fundamental notions of analysis, 2 hours; analytic geometry, 3 hours through 3 semesters; elements of the theory of functions, 3 hours; elements of the theory of numbers, 2 hours; algebraic equations, 4 hours; introduction to descriptive geometry, 2 hours; characteristic features of infinitesimal calculus, 3 hours during 2 semesters; theory of groups and algebraic equations, 2 hours; selected chapters of analytic geometry, 2 hours; vector analysis, 2 hours; differential equations, 3–5 hours; contact transformations, 2 hours; theory of transformations, 5 hours. An equally elaborate

series of courses is offered in the Bohemian section of the University of Prague.

Mathematical instruction in Austria is much handicapped by reason of the fact that the faculties of the universities are so sparsely staffed with professors of pure and applied mathematics. In 1909–10, except at Vienna, no university had more than two such professors and only four had even one Privatdocent. In Italy and Russia the number of these professors per university averages nearly twice as many as in Austria; in France and Germany nearly one and one-half times as many. Indeed, at each of a score of universities in these four countries there are more professors of mathematics than even at the University of Vienna.

In a memorial presented in 1908 to the minister of public instruction and finance on behalf of the faculties of philosophy in Austrian universities the following normal program of mathematical study at a university for a candidate as a teacher in a Gymnasium was outlined:

First year.—Introduction to mathematical analysis and to differential calculus, elements of integral calculus with exercises, 5 hours a week. Introduction to geometry; first principles of analytic and synthetic geometry, with exercises, 3 hours a week. A course of mathematics for students of physics and chemistry, 5 hours a week.

Second year.—Integral calculus and first principles of the theory of functions of complex variables, with exercises, 5 hours a week. Analytic and differential geometry, with exercises, 5 hours a week. Principal properties of algebraic equations and elements of the theory of numbers, with exercises, 3 hours a week.

Third, fourth, and later years.—Higher courses on the theory of differential equations, the calculus of variations, the theory of functions, the theory of groups of transformations, on the principles of arithmetic and of geometry, etc., at least 3 hours a week. Seminary for mathematical analysis, 2 hours a week. Seminary for geometry, 2 hours a week. Seminary for the theory of numbers and higher algebra, 2 hours a week.

On this scheme the memorial comments as follows:

But it should be emphasized that this program indicates only that which is absolutely necessary for future professors in Gymnasien; if one wished to obtain a more extended preparation, which it should be the principal aim of the university to furnish, it would be necessary to augment this program by a whole series of courses in special fields of pure mathematics and on different branches of applied mathematics.

The program indicated corresponds, then, only to a minimum. Now, the execution of such a program requires at least three professors, and further, this number will only suffice if each of two of the three chairs has an assistant at its disposal. The exercises corresponding to elementary courses ought to be directed by assistants under the control of professors. For, in order that exercises be truly profitable, it is necessary that they be individual, as has been the case for a long time in higher technical schools for all practical branches and for descriptive geometry. That is to say, it is not sufficient to work out some examples on the blackboard in the classroom with one or more students; rather is it necessary to lay before the students a selection of examples from which they then choose according to their personal inclinations some problems to solve under the guidance of the professor and assistant. This personal activity, even to such a minor degree, is particularly valuable for the future professor; for, in his teaching he ought to display certainty and enthusiasm. On the other hand, the proposed reform of the teaching of mathematics in the secondary schools demands a suitable preparation of the professor.

Since of course the whole scheme of instruction in a country depends first of all on instruction in the university—that is to say, since a good organization of university instruction is of capital importance for general instruction—the faculty of philosophy of the Austrian university regard it as urgent to satisfy these exigencies of university instruction.

There ought then to be at least three chairs of mathematics in the faculty of philosophy of every Austrian university, one in each of the following fields: (*a*) For the theory of numbers and higher algebra; (*b*) for mathematical analysis; (*c*) for geometry. At least two of these chairs ought to be held by "ordinary" professors provided with assistants.

As this memorial did not bring about any material change in the situation, we remark that in most Austrian universities the opportunities for scientific preparation of the professor of mathematics in secondary schools are inadequate.

II. Having noted typical general courses which may contribute to this training, let us next consider the special courses. There were no special courses given by Privatdocenten in the German division of the University of Prague during the five-year period referred to above. At the University of Vienna, however, Privatdocenten offered the following courses: Mathematical statistics, 3 hours, during 2 semesters; elliptic functions, 2 hours, during 2 semesters; quaternions and other hypercomplex number systems, 2 hours; theoretical arithmetic, 3 hours; differential geometry, 2 hours; potential theory, 2 hours; Pfaff's problem, 2 hours; elementary theory of functions, 3 hours, during 2 semesters; functions of a single real variable, 2–3 hours, during 2 semesters; hypergeometric series, 2 hours; infinite double series, 2 hours; infinite groups, 2 hours; theory of numbers, 3 hours; foundations of geometry, 2 hours, during 2 semesters; finite discrete groups, 2 hours; review of more recent mathematical works, 2 hours; complex number systems, 2 hours; selected chapters of higher algebra, 3 hours; calculus of variations, 3 hours, during 2 semesters; theory of integral transcendental functions, 2 hours; determinants, 1 hour; the principle of duality in geometry, 2 hours; integral equations, 3 hours; selected chapters of theory of functions, 2 hours; analysis situs, 2 hours, during 2 semesters; Taylor's series and its analytic extension, 2 hours; synopsis of differential calculus with applications, 3 hours; general theory of groups, 2 hours.

The number of these courses offered at the University of Vienna is nearly twice as large as the total of similar courses offered at all other Austrian universities during the same period. The three courses given at the University of Krakow were: Mathematics in Poland at the end of the seventeenth century, 1 hour; Arabian mathematics, 1 hour; history of mathematics in antiquity and the Middle Ages, 2 hours.

Special lectures on topics having more direct connection with the mathematical work in secondary schools are not numerous. Occasional courses on selected chapters of elementary mathematics have been given by Prof. Zindler at Innsbruck. Prof. von Sterneck claims that the two-hour year course on elementary mathematics which he first offered in 1909–10 and which was organized so as to be given every third year at the University of Gratz, was the only regular course of this nature in an Austrian university. He tells us that he expounded thoroughly the laws governing positive integers; discussed the introduction of negative integers in the usual way; treated rational numbers in a purely abstract manner as number pairs; discussed in detail Cantor's theory of number sequence and the related theory of irrational numbers, as well as the successive extensions of the idea of power. In order to discuss exactly the convergence of infinite series, especially the geometric, the idea of regular sequence was also introduced. Rules governing operations on complex quantities defined in connection with pairs of real quantities were presented in detail and the connection with the n roots of unity mentioned. The foundations of geometry were not presented with the same completeness as to rigor. There the didactic points of view, first recommended by Borel and already employed by Suppantschitsch in his textbooks on geometry for the secondary schools, were developed, the questions of the independence of the axioms being left entirely to one side.

Spherical trigonometry is not taught in the Gymnasien. At most universities the fundamental formulæ are derived in the lectures on analytic geometry of space; for example, at Krakow, Gratz, and Innsbruck. More extended development occurs in seminary exercises; for example, those of Gmeiner, at Innsbruck, and Mertens, at Vienna; the latter in his proseminary lectures on spherical trigonometry and considers the analogues on the sphere of such results as Feuerbach's theorem and Malfatti's problem. Otherwise, spherical trigonometry is developed in the lectures on astronomy.

Many persons feel strongly that regular lectures on descriptive geometry should be given at all Austrian universities,[1] but so far such courses have been established at Gratz and Innsbruck only.

III. At every Austrian university, in addition to the lectures, there are mathematical seminary exercises which allow of a certain amount of individual activity on the part of the student as opposed to the compulsory receptive attitude in the lecture room. Each "ordinary" professor is supposed to conduct a section of such seminary exercises. These exercises are for both beginners and advanced students.

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[1] Cf. E. Müller, "Anregungen zur Ausgestaltung des darstellend-geometrischen Unterrichts an technischen Hochschulen und Universitäten." *Jahresbericht der deutschen Mathematiker-Vereinigung*, Band 19, 1910, pp. 19–24.

The section for beginners is referred to at the universities of Vienna, Prague (Bohemian), and Czernowitz as proseminary. The number of hours per week devoted to all seminar exercises varies from 2 at Gratz and Innsbruck to 4 (2 hours proseminary) at Czernowitz in the winter semester and 4 at Krakow; of the 3 hours a week at Vienna, one hour is for the proseminary.

Active participation of members of the seminary in its exercises is not generally compulsory. An exception to this is in the section of the seminary conducted at Gratz by Prof. v. Dantscher, who requires three students each semester to work on some topics, usually quite independent of subjects of lectures during that semester, for presentation before fellow students. This gives the students in the seminary opportunity to learn, with the aid of the professors' criticisms, how such matters should be treated, before the preparation of the required "Hausarbeit" in connection with the examination for secondary school teachers (Lehramtsprüfung). Examples of themes of such required papers are as follows: Explanation of the convergence of an additive aggregate of infinitely many rational numbers; examination of the connection between m functions of n variables (Dini); the projective generation of space curves of the third order; discussion of double integrals.

In most cases the exercises are oral. Those for the proseminary have, mainly, direct connection with the current lectures. In the seminary the topics are chosen sometimes on the initiative of the students and sometimes on the recommendation of the professor. As a general thing it has been found that about one-half of those who regularly attend seminary exercises participate in its discussions. The value of such participation is generally recognized, and Prof. v. Dantscher has proposed that it should be required, during two semesters at least, for all candidates as teachers in secondary schools, just as exercises in experimental physics are required.

Examinations.—The present decrees regarding the preparation of secondary school teachers were promulgated in 1911. These require that candidates shall pass two examinations: (1) A preliminary examination on philosophy and pedagogy; (2) the Lehramtsprüfung. While more or less preparation for these examinations is provided at the universities, the examinations are not conducted by the universities, but by State examination commissions whose members are, however, mostly university professors.

(1) In the preliminary examination the candidate must show that he has acquired the knowledge of philosophy and pedagogy essential for every teacher. This knowledge should embrace the main ideas and principles of the theory of education and instruction and their

theoretical foundations in psychology and logic, as well as general survey notions of the principal periods of the history of higher education since the sixteenth century.

The candidate is not admitted to this examination before the end of the fifth semester. In preparation for it he is recommended to take a four-hour course of lectures in pedagogy, a four-hour course in philosophy (especially psychology), and, when possible, courses in school hygiene and in the methodology of his special subjects. He is also strongly recommended to take part in seminary exercises in pedagogy and in his special subjects.

The examination is conducted by the professors in philosophy and pedagogy under the guidance of the director of the examination commission, or of his deputy, and lasts about half an hour. The commission gives the candidate a certificate as to the results of the examination. If a candidate is not admitted to the examination on account of inadequate preparation, he is not allowed to present himself for examination again until another semester has elapsed. A certificate that he has passed the preliminary examination must be presented to the commission with the application for admission to the Lehramtsprüfung.

(2) The time required, as student in a university, in preparation for the Lehramtsprüfung is about three and one-half or four years, and the examination is the same whether the candidate is later to be a teacher in the Gymnasium or in the Realschule.

The examination is on subjects grouped in a certain way. Those groups which involve mathematics are:

(*a*) Mathematics and physics as majors.

(*b*) Descriptive geometry and mathematics as majors.

(*c*) Natural history as major, mathematics and physics as minors.

(*d*) Natural history as major, mathematics and geometrical drawing as minors.

(*e*) Philosophy and mathematics as majors and physics as minor.

(*f*) Chemistry as major with mathematics and physics as minors.

For mathematics as major the official requirements are: Knowledge of "general arithmetic," of the foundation of higher algebra and theory of numbers and their significance for elementary mathematics; elementary geometry, synthetic and analytic geometry, of the plane and of space; foundations of descriptive geometry; differential and integral calculus and its applications to geometry, the elements of the calculus of variations; familiarity with the foundations of modern theory of functions; and acquaintance with the principal results of the investigations concerning the foundations of mathematics.

For mathematics as minor: Knowledge of elementary arithmetic, insight into the structure of the field of real numbers and into operations with them; knowledge of elementary geometry to the extent of what is taught in secondary schools, and exercises in space perceptions; accuracy and speed in the solution of simple examples applying the idea of a function and the elements of differential and integral calculus to functions coming up in secondary school work.

For (*a*) *descriptive geometry and* (*b*) *geometrical drawing:* (*a*) Thorough grounding in orthogonal, oblique, and central methods of projection including axonometry, knowledge of relief perspective, of the most important map projections, especially of stereographic projection and of cyclography. Familiarity with the constructions relating to curved lines (especially curves of the second order, space curves of the third and fourth order and helices) and curved surfaces (chiefly surfaces of the second order, surfaces of revolutions, helicoidal, ruled and envelope surfaces, particularly in lighting-constructions). Acquaintance with some applications of descriptive geometry (as construction of sundials, roof trusses, sections of stone (stereotomy)). Knowledge of projective and infinitesimal geometry in so far as these subjects are necessary in the applications of descriptive geometry. Exactness and facility in constructive drawing.

(*b*) Elements of descriptive geometry to the extent of the program of Realschulen. Axonometric representations. Elements of shadows and linear perspective; the geometrical construction of, and by means of, polygons and the most important plane curves, especially the conic sections. Exactness and facility in constructive drawing.

Each examination comprises three parts: The *Hausarbeiten* (theses), the written examinations, and the *oral examinations*.

To prepare each of the theses the candidate has three months. These theses need not necessarily show capacity for discovery on the part of the candidate, but they must indicate thorough familiarity with the literature and content of the subjects. In connection with a very large subject a general presentation of the outstanding results may be permissible. Again, certain illustrations of a theory may be worked out. The character of the topics is shown by the following selection of themes of theses in recent years. (None of these subjects were discussed in the lectures at universities where they were assigned.)

(*a*) For major:
- The theory of Fourier's series.
- The isoperimetric problem.
- Systematic presentation of the proofs of the fundamental theorem of algebra.
- On Abel's equation.
- Theta functions and their applications in the theory of surfaces of the fourth order.
- Historical presentation of the progress in the theory of algebraic equations (in its leading features).
- Triply orthogonal systems of surfaces.
- Transcendental numbers, especially e and π.
- Jacobi's functional determinants and their most important applications.
- Method of derivation of large prime numbers.

(*a*) For major—Continued.
  - The series for $\tan x$ and $\sec x$ and the most important properties of their coefficients.
  - The significance of π in the calculus of probabilities and theory of errors.
  - Focal properties of surfaces of the second degree.
  - Algebraic treatment of the 27 lines on a surface of the third order.
  - Reye's complex.
  - Rational space curves of the fourth order.
  - Study of the representation by $w=\int\frac{dz}{\sqrt[3]{(z-a)\,(z-b)\,(z-c)}}$.

(*b*) For minor:
  - Solution of equations of the third and fourth degree.
  - Properties of the nine-point circle.
  - Theorems of Pascal and Brianchon and their proof in the case of the circle.
  - The general term of the Lamé series and the proposition with regard to the greatest common divisor of two expressions.[1]
  - Elementary geometric treatment of the problem of tangencies of Apollonius.
  - A presentation of pages C_2–G of Girard's *Invention nouvelle en l'algèbre* (1629) in modern mathematical phraseology and notation.
  - The determination of the 15 Archimedean solids in terms of the radius of the circumscribed sphere.
  - Weierstrass's theory of irrational numbers.
  - The theorems of Fermat and Wilson.

In connection with the written and oral examinations, questions are usually asked on the theory of symmetric functions, the algebraic solution of equations of the first to the fourth degrees, and better candidates may also be questioned on the elements of the theory of groups and on the proof of the impossibility of the algebraic solution of equations of degree higher than the fourth. Questions on the calculus of variations are usually omitted. In general, clarity of perception and certainty in handling fundamental theorems are valued more than the extent of minute knowledge.

In the written examination there is also opportunity to indicate ability to apply theoretic knowledge to practical problems. Further, the examinations pay special attention to the subjects of the students' university lectures and seminary exercises. The written examination for a major lasts eight hours, two sessions of four hours on the same day; for a minor four hours are allowed.

In 1908–1910, 241 persons passed the professorship examination, with mathematics and physics as majors; 89 at Vienna, 80 at Prague, at Czernowitz, etc., only 1.

Comparatively few students in Austria proceed to the doctorate in mathematics—less than 50 in the last 45 years. Half of these were at Vienna.

In the examinations of candidates with mathematics as a minor—that is, of those who may expect to become teachers in the lower mathematical classes of the middle schools—the ground covered is usually that of the Maturitätsprüfung. Some examiners also demand spherical trigonometry and such things as the solution of an equation of the third degree or lay special emphasis on the development of the power of space perception.

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[1] This title refers to G Lamé's "Note sur la limite du nombre des divisions dans la recherche du plus grand commun diviseur entre deux nombres entiers", *Comptes Rendus*, 1844, tome 19, pp. 867–870. The series of numbers 1, 1, 2, 3, 5, 8, 13, 34, . . . , which here comes up, is the recurring series often called the Fibonacci Series.

It is felt very strongly by some Austrian educators that the lower standard for teachers in the Untergymnasien and Unterrealschulen is decidedly detrimental to the best interests of these institutions.

After a candidate for a professorship in a secondary school has passed the professorship examination, he has yet to undergo a "trial year" before he can be assigned to a post. At least this is true in theory; in practice the need for teachers has been so great that most of them have not had adequate professional preparation. Of over 200 candidates approved by the Vienna examination commission and supposed to be having a "trial year" in 1908–9, only one actually completed the work of the year.

This trial year is passed in a Mittelschulseminar, which is most successful when it is directly connected with a Gymnasium or Realschule. On entering the Seminar the student is placed under a certain professor who has charge of his development during the trial year. In the first few weeks the candidate visits classes which his professor teaches, and notes the methods employed and the personality of the pupils. The candidate next gives instruction with the aid or under the direction of the professor. At the beginning of the second semester the candidate instructs without aid for at least a month. Furthermore, all candidates have weekly conferences with the guiding professor and the director of the Seminar with reference to various questions regarding instruction, school discipline, pedagogy, school hygiene, and notable publications in pedagogic literature.

After 8 years of service professors in secondary schools are entitled to a small pension in case of need. The rate of pension gradually increases until after 30 years of service it amounts to full salary.

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[1] See also *L'Enseignement Mathématique*, tome 10, 1908, pp. 516–522; tome 12, 1910, pp. 326–341; tome 13, 1911, pp. 159–166, 237–243, 332–33; tome 15, 1913, pp. 79–84, par J. Renard.

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III. BELGIUM.

The area of Belgium is less than that of the States of Maryland and Delaware together, but the population is somewhat greater than that of the Dominion of Canada.

Education is controlled by the minister of sciences and arts, who has under him two general directors, one for primary and one for secondary and higher education. For secondary education the ministry also has an inspector general, nominated by the King, and two ordinary inspectors, one for the humanities, the other for mathematics and science. Authority is exercised over schools by the ministry in effective manner through control of the Government appropriations, appointment of teachers, regulation of programs, and prescription of textbooks.

SECONDARY SCHOOLS.

In Belgium the better secondary schools proper may be roughly divided into two classes, those supported by the Government and those maintained by the communes. The former are of two kinds: (*a*) the *Athénées Royaux* (royal athenaeums, called also higher middle schools); and (*b*) the Lower Middle Schools or Middle Schools. The communal secondary schools (*collèges communaux*) are mostly controlled by the church or religious orders. In 1912 they included 15 collèges, which ranked about as high as the athénées.

(*a*) The athénées royaux, 20 in number, are subject to official control under the direction of the King. In accordance with a decree of 1888 the courses in the athénées were arranged in three parallel divisions: (1) The *humanités grecques-latines*, with seven years of Latin and five years of Greek; (2) the *humanités latines*, with seven years of Latin, no Greek, and a very extensive course in mathematics; (3) the *humanités modernes*, where modern languages serve as the basis for teaching during the seven years. The three higher classes of the *humanités modernes* comprise two sections, the scientific section and the commercial section.[1] The classes during the seven years of each of the divisions are numbered VII–I. Pupils entering VII are about 12 years of age[2] and have had the equivalent of 6 years of training in the primary schools.

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[1] Note that the scheme is somewhat similar to that of the French lycées. In Germany these different types of instruction are given in different schools: the Gymnasium, the Realgymnasium, and the Realschule.

[2] The minimum age of admission to the athénées is 11 years, and an entrance examination must be passed.

The mathematical subjects taught in the athénées are arithmetic, algebra, plane and solid geometry, plane and spherical trigonometry, plane and analytic geometry, descriptive geometry, and surveying.

Number of hours per week devoted to mathematics and its applications in the different divisions.

	VII	VI	V	IV	III	II	I	Total.
Greek-Latin humanities [1]	3	3	3	3	3	3	3	21
Latin humanities [1]	3	3	4	4	6	6	8	34
Modern humanities:								
(a) Scientific section	3	3	4	4	6	6	8	34
(b) Commercial section	3	3	4	4	3	3	2	22

[1] The courses in ancient humanities bifurcate at the beginning of the third year, V.

In the first two years the mathematics is the same for all, and the programs for the Latin humanities and the scientific section of the modern humanities are identical. The commercial section differs from the scientific section in Classes III–I only. In Class III of the scientific section the following subjects are taught:

In *arithmetic:* General theory of divisibility of numbers, highest common divisor, least common multiple, theory of prime numbers, Fermat's Theorem, conversion of ordinary fractions into decimal fractions and reciprocally, numerical approximations, weights and measures, operations on complex numbers, cube root. In *algebra:* Discussion of the general equation of the first degree in one and two unknowns, complete discussion of the general equation of the second degree, properties of trinomials of the second degree, questions of maxima and minima, progressions, logarithms, use of tables, compound interest, and annuities. In *geometry:* Regular polygons, measure of the circle, determination of π, problems, notions on the theory of transversals. In *plane trigonometry:* Fundamental formulæ, identities, construction, and usage of trigonometric tables, solution of triangles. *Surveying and leveling.*

In Class I of the Latin humanities two of the eight hours a week are devoted to a thorough review of algebra, geometry, and trigonometry, with new applications of the theories. In the remaining six hours some of the topics taken up are:

Determinants of the second, third, and higher orders; elementary properties, application to the solution of a system of n equations of the first degree; in *spherical trigonometry:* Solution of triangles, spherical excess, radii of inscribed and circumscribed circles of a triangle, distance between two points on the earth's surface, volume of the parallelepiped and tetrahedron in terms of the edges and angles; in *analytic geometry:* Principal properties of points, lines, conics, conics as sections of a cone, intersection and similitude of two conics; in *descriptive geometry:* Introductory notions.

It may be added that the instruction in the athénée is maintained at a very high standard and carried out in such way as to arouse keen competition for honors and prizes. These are distributed as the outcome of three examinations each year for each class, the third being called the *Concours général.* A sample paper in the *Concours général* of 1910 for Class I in Latin humanities and scientific section will give a further indication of the mathematical standards of the athénée:

I. *Analytic geometry.*[1]—Given a rhombus $ABCD$ whose diagonals AC, BD, are, respectively, equal to $2a$ and $2b$, and intersect in O. (*a*) Form the general equation of the conics S whose conjugate diameters have the directions of the sides BA, BC, and which meet the diagonal AC in two points E and F such that, $OE \times OF = -a^2$. Show that the conics S pass through four fixed points and construct these points. (*b*) Find the locus of the poles of AC with respect to the conics S. Find also the locus of the points of contact of the tangents drawn to the same conics, parallel to AC. (*c*) Consider, in each of the conics S, the axes of symmetry I, the polar p of the vertex D, and the perpendicular d dropped from D on p. Find the locus of the points of section of d with I and construct this locus. II. *Descriptive geometry.*—Given a line c, and the horizontal line a cutting the frontal line b in the point A. (*a*) Find on the line c the point S, equally distant from the sides of the acute angle formed by a and b. (*b*) From S drop the perpendiculars SD, SB on a and b, respectively. (*c*) Construct the quadrangular pyramid S-$ABCD$, which is found by cutting with the plane (a, b) the solid angle whose four edges are SA, SB, c, SD. (*d*) Give a representation of this pyramid, applying the conventions with respect to the parts of the drawing of projections of parts seen and hidden. III. Demonstrate that the six dihedrals of a tetrahedron satisfy the relation,

$$\begin{vmatrix} -1 & \cos(ab) & \cos(ac) & \cos(ad) \\ \cos(ba) & -1 & \cos(bc) & \cos(bd) \\ \cos(ca) & \cos(cb) & -1 & \cos(cd) \\ \cos(da) & \cos(db) & \cos(dc) & -1 \end{vmatrix} = 0,$$

where the four faces are denoted by a, b, c, d, and (pq) denotes the dihedral angle formed by the faces called p and q.

If the trihedral angle formed by the faces a, b, c is trirectangular, show that the preceding equality reduces to

$$\cos^2(ad)+\cos^2(bd)+\cos^2(cd)=1.$$

The student who completes any one of the courses of instruction in an athénée and passes the final examination receives a *diplôme de sortie,* which admits him to the goal of his ambition, a university. It will admit him to any faculty. Only in the special schools must an applicant for admission, whether he has a *diplôme* or not, be examined on the program of the Latin or scientific sections.

(*b*) The State lower middle schools, of which there are about 90 for boys,[2] "were created by the Government to meet the needs of the higher artisan and commercial classes." Entering pupils for these schools and for the athénées have the same preparation. The courses of study are arranged so as to occupy three years. The obligatory courses are: French, Flemish, history, geography, arithmetic, algebra, geometry, zoology, botany, physics, chemistry, commerce, drawing, and gymnastics. As to mathematics, it corresponds approximately to what is taken up in the first four years at the athénées.[1] Pupils who have completed the course of a lower middle school are admitted to IV of an athénée without examination or to III after successfully passing an examination.

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[1] For solution of these questions, see *Mathesis,* 1911, vol. 31, pp. 35–38, 61, 67.

[2] Mr. Rose seems to be incorrect in stating (p. 351) that there are only about 50 of these schools. *Cf. Statesman's Year-Book,* 1917, and Reports of the U. S. Commissioner of Education, 1913–14, etc.

THE UNIVERSITIES.

There are no higher normal schools in Belgium, and except in very rare instances a candidate for a professorship in an athénée must have received the degree of doctor from a university.

There are four universities—two belonging to the State, at Ghent and Liege; the free university at Brussels; and the largest of all, the Roman Catholic university at Louvain.[2] Each of these universities has certain special schools or institutes connected with it. Perhaps the most famous of them is the technical school attached to the University of Liege. In each of the universities there are four faculties—philosophy, law, medicine, and sciences. It is in connection with the last-named faculty that the future professors of mathematics and professors of natural science are formed. On entering the faculty of science as students these candidates are required to present a *diplôme de sortie* from an athénée or a *collège*, or else to pass equivalent examinations either (1) before the faculty or (2) before a jury composed of professors of secondary teaching and appointed by the minister of sciences and arts. The students are usually graduates from the scientific section of an athénée.[3]

In addition to pure mathematics the future professor is required to study general physics and mathematical physics, rational mechanics, chemistry, and crystallography. The program also includes a course in psychology, logic, and moral philosophy, as well as in the history of mathematics.

Didactic preparation takes place at the same time as scientific preparation, each university possessing a special chair of mathematical methodology.

The scientific preparation extends over four years. During the first two years the student prepares to secure the certificate as *candidate in physical sciences and mathematics*. For three years the courses are the same for all the students of mathematics; in the fourth year each takes up, according to his tastes, one or other of these groups: Analysis (including differential geometry), higher geometry, astronomy and geodesy, rational mechanics and celestial mechanics, physics. The thesis for the doctorate is on a question related to the group chosen.

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[1] Selected titles from the official list of ma the matical texts used in the athénées and lower middle schools are given on pages 234-235 of the report of the subcommission.

[2] The buildings of this university were completely destroyed by the Germans Aug. 26, 1914.

[3] To meritorious and needy students the State awards, on the basis of a *concours*, annual scholarships amounting to 400 francs. These scholarships may be received each year of the course. There is generally one such scholarship for the section of mathematics in each university.

The materials of the program, which are about the same for all universities, have been arranged in the following manner by Mr. Rose:

(a) PURE MATHEMATICS.

1. *Analysis—First year.*—Differential and integral calculus. Three hours a week. Limits; aggregates; derivatives and differentials; Taylor's and Maclaurin's theorems; explicit and implicit functions; change of variable; maximum and minimum; series; geometric applications of differential calculus to curves and to surfaces; integrals—processes of integration; various types of integrals; areas, surfaces, volumes.

   Second year.—Definite integrals, differentiation and integration; Eulerian integrals; differential equations; integrable types; simultaneous differential equations; partial differential equations of the first order; total difference equations; calculus of differences and calculus of variations. Three hours a week.

   Third year.—Theory of a complex variable; synectic functions; study of works of Abel, Cauchy, Riemann, Weierstrass, and their disciples. Theory of elliptic functions (after Legendre). Three hours a week.

   Fourth year.—Six hours a week, and more for students working for their doctorate in analysis. Searching study of a topic in the theory of functions. Elliptic functions according to Jacobi and Weierstrass. Research in differential geometry based upon the work of Darboux[1] and Bianchi.[2]

   The masterly work of M. de la Vallée-Poussin[3] gives a good idea of the subjects covered in the first two years.

2. *Analytic Geometry—First year.* Three hours a week. Revision of analytic geometry of two dimensions and study of analytic geometry of three dimensions. Particular study of homogeneous, tangential, triangular, and tetrahedral coordinates. Generation of surfaces. Surfaces of the second degree. For such work the notable treatise by Servais of the University of Ghent may be consulted.

   Second year. Three hours a week. *Projective geometry:* Study of forms, involution, homography, homology, correlation, duality, polarity, properties and generation of conics, pencils, nets, generation of quadrics, properties. The texts of F. Folie,[4] F. H. G. Deruyts, and of Servais[5] illustrate the requirements.

   For the pupils who specialize in geometry during their third and fourth years, the professor takes up either the theory of plane and cubic curves and of cubic surfaces, or the theory of forms in higher geometry. The number of hours per week depends on the professor. The works of F. Folie, F. H. G. Deruyts, M. Stuyvaert, Fairon,[6] and L. Godeaux may be mentioned.

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[1] G. Darboux: I. *Leçons sur la théorie générale des surfaces.* 4 parties. Paris, Gauthier Villars. 1:2e éd., 1914, 7+618 pp. 2:2e éd., 1915, 3+579 pp. 3:1894, 8+512 pp. 4:1896, 8+548 pp. II. *Leçons sur les systèmes orthogonaux et les coordonnées curvilignes.* 2e éd. Paris, Gauthier Villars, 1910. 3+567 pp.

[2] L. Bianchi, *Lezioni di geometria differenziale.* 3 vols. Pisa, Spoerri, 1902–1909 (2d edition of volumes 1–2). Second German edition by M. Lukat. Leipzig, Teubner, 1910. 18+721 pp.

[3] C. J. de la Vallée-Poussin, *Cours d'analyse infinitésimale.* 2 tomes. Louvain, Dieudonné, 1:3e éd. 1914; 2:2e éd. 1912. 9+452+9+464 pp.

[4] F. J. P. Folie, *Éléments d'une théorie des faisceaux.* Bruxelles, Hayez, 1878. 110 pp. *Géométrie supérieure cartesienne,* Bruxelles, Hayez, 1872.

[5] C. Servais: 1. *Sur les imaginaires en géometrie, application aux cubiques gauches.* Gand, 1894. 2. *Cours de géométrie analytique.* 2e éd. Gand, 1906.

[6] J. Fairon, *Sur les involutions du quatrième ordre.* Bruxelles, Hayez, 1909, 68 pp.—M. Stuyvaert, "Recherches relatives aux connexes de l'espace" (1901) and "Étude de quelques surfaces algébriques engendrées par les courbes du deuxième ou du troisième ordre" (1902).—F. Deruyts, "Mémoire sur la théorie de l'involution et de homographie unicursale" (1890).

(*a*) PURE MATHEMATICS—Continued.

3. *Algebra*—Thorough study of determinants. General theory of equations; resolution and methods of approximation to the roots, study of imaginaries. Two hours a week in the first year. Texts: Algebra by J. Neuberg or by P. Mansion.
4. *Calculus of Probabilities—Third year.* One hour a week. Principles and problems; various species of probabilities. Bernoulli's theorem; theory of play; law of large numbers; theory of least squares; application to annuities and life insurance. Text by Boudin.[1]

(*b*) APPLIED MATHEMATICS.

5. *Astronomy—Second year.* Physical astronomy. Three hours a week. Study of the system of the world, systems of coordinates, motions, sun, moon, planets, stars, comets. Applications of spherical trigonometry, elements of geodesy. Text: Astronomy (Collection Léauté) by Stroobant.[2]

   Third year. Three hours a week. Mathematical astronomy, application of analysis to astronomy, refraction, eclipses, calculation of orbits.

   In the fourth year the students make a thorough study of some branch of mathematical astronomy.
6. *Descriptive Geometry—First year.* Four hours a week. Review of the principles of the point, the line, and the plane. Study of trihedral angles, of curves and of surfaces, surfaces of the second degree and ruled surfaces, intersections, géométrie cotée. Treatises: By Chomé,[3] Breithof,[4] de Locht, Van Rysselberghe, and Chargois.
7. *Rational Mechanics—First year.* One hour a week. Vector geometry and statics: Forces, equilibrium, virtual velocities, funicular curves, machines.

   Second year. One hour a week. Kinematics: Velocity and acceleration, finite motion, instantaneous motion, continuous motion.

   Third year. Dynamics. Three hours a week. Study of the motion of free point, of a point on a surface or on a curve. Relative motion. D'Alembert's principle and the general equations of dynamics (Lagrange and Hamilton). Motions of a system. Rigid systems. Percussions. Attraction of ellipsoids. Mechanics of fluids; hydrodynamics. Text: The remarkable work by Massau.[5]

   Students who continue the study of mechanics during the fourth year take up equations of mechanics and the principal theories of celestial mechanics.
8. *Mathematical Physics—Third year.* Three hours a week. Study of the principal theories of optics, of magnetism, and of electricity.

(*c*) 9. HISTORY OF MATHEMATICS.

Third year. Two hours a week. Mathematics in antiquity among the Egyptians, Assyrians, Chaldeans, Greeks, and Romans. Mathematics of the Hindus and Arabs. Middle ages.

Fourth year. Two hours a week. Renaissance, modern times, contemporary history, detailed study of each of the branches: Arithmetic, algebra, geometry, analysis, mechanics, physics.

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[1] E. J. Boudin, *Leçons sur le calcul des probabilités.* The first edition was published anonymously in autograph form in 1865; 3e éd. (same as second). Gand, De Witte, 1889. Autographie, 125 pp.

[2] P. Stroobant, *Précis d'astronomie pratique.* Paris, Masson, 1903. 188+16 pp.

[3] F. Chomé: 1. *Cours de géométrie descriptive.* 3e édition entièrement revue, corrigée et augmentée. 3 vols. Bruxelles, 1898–1904. 2. *Éléments de géométrie descriptive.* Bruxelles, Kouwenaar, 1896. 12+159 pp.

[4] N. Breithof, *Cours de géométrie descriptive: surfaces, courbes.* 2 vols. Louvain, 1875.

[5] J. Massau, *Cours de mécanique.* 2 vols. Gand, Meyer Van Loo, 1892–1896. (Autographié.) 365+8+312 pp. *Leçons de mécanique rationnelle,* 2 tomes. Gand, L'association des ingénieurs sortis des écoles spéciales, 1911–1913. 15+259+17+343 pp.

(c) HISTORY OF MATHEMATICS—Continued.

10. *Elementary Mathematics.*

In the course on methodology (three hours a week, fourth year) the principles and foundations of such matters are considered. Review of the principal theories studied in the athénée with a view to practical lessons. Notions of higher arithmetic, of various kinds of geometry, of transcendental numbers. Text: Methodology, by Dauge.[1]

(d) OTHER COURSES.

11. *General Physics—First year.* Four hours a week. Study of the principal theories of experimental physics. Treatises: By Schoentjes and Heen.
12. *Chemistry—Second year.* Four hours a week. General organic and inorganic. Treatises: By Swarts, A. F. Spring, P. Henry, Chavanne.
13. *Psychology, Logic, and Moral Philosophy—Second year.* Three hours a week. The principal theories especially of logic.
14. *Crystallography—Second year.* Three hours a week. Systems, properties, representation. Types and properties of minerals. Treatises: By E. A. Stöber, G. Cesàro, Ledoux.

Students in a university have to pass annual examinations on each of the subjects of study during the year[2] before being admitted to the work of the following year. Having satisfactorily completed the first two years of work they receive diplomas as *candidats.*

The tests at the end of the fourth year include: (1) The presentation and public defense of a thesis; and, for those who are to become teachers, (2) the public delivery of two lessons, one on mathematics, the other on experimental physics. The subjects of these lessons are given in advance by the jury and are chosen from the program of the athénées. All tests having been successfully passed, the candidate becomes a doctor of physical sciences and mathematics.

The examinations occur each year in July and in October, and there are several grades of diplomas: With success, with distinction, with great distinction, and with greatest distinction.

PROFESSIONAL PREPARATION.

It is noteworthy that the program for the doctorate includes the elements of the history of mathematics and a course on methodology of the teaching of mathematics and of physics. This latter course deals equally with subjects taught in the athénée and with the methods of mathematics in general. The course lasts one or two years (third and fourth) and averages about three hours a week. The lessons are conducted by a university professor who has generally been a teacher in the secondary schools in his earlier career. They have a bearing on the methods of teaching each of the parts of the program of the athénée, and the professor usually expounds each of these subjects through the medium of the students themselves, aided by his counsel and advice. Each student gives before his fellows practical lessons in mathematics and physics. These are afterwards passed under critical review by professor and students.

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[1] F. Dauge, *Cours de méthodologie mathématique.* 2e [last] édition. Gand, Hoste, 1896. 10+525 pp.

[2] The pass mark is 50 per cent.

While students are required to take a course in psychology, pedagogy is not taught at all systematically.

It is with such scientific and professional preparation that the future teacher in the better secondary schools enters upon his duties.

TEACHERS IN SECONDARY SCHOOLS.

In the athénées the teaching staff consists of an inspector of studies (*préfet des études*), professors, and masters (*surveillants*). The head of a lower middle school is called a *rector*. The inspectors, rectors, and professors are nominated by the King, and must each have secured the doctor's degree at a university. The masters, who are chosen from candidates, are appointed by the minister of sciences and arts.

In general the newly made doctor enters first either (1) as professor in a free school (*établissement libre*) or communal college; or (2) as temporary or permanent surveillant; or (3) as substitute professor in an athénée. After some years have passed in one or another of these capacities, he may be promoted to a chair in an athénée; but in many cases the doctor must proceed to this goal by way of the position as surveillant.

The mathematical chairs vary in attractiveness, according to the divisions: (A) Greek-Latin, (B) Latin, (C)–(D) modern humanities, with which they are connected. In establishments of secondary importance (averaging about 200 pupils) there are ordinarily three professors of mathematics, one for division (A) in VII and VI, the course being the same for the divisions (A) and (B); a second for the modern humanities VII, VI, V, and IV, and for (B) V and IV; finally a third for division (C): III, II, I scientific, and division (B): III, II, I. There is only one corresponding professor in each athénée; he is the *professeur de mathématiques supérieures*. So, also, there is always only one professor in division (A). On the other hand, the number of professors in the division of modern humanities may be two or three and sometimes four, according to the number of pupils (400 to 700).

But in any case as there are only 20 athénées, and a smaller number of similar ranking collèges communaux, the number of mathematical chairs is relatively limited.

The number of teaching hours per week varies from 18 to 21, according to the divisions.

The salary is composed of two parts: (1) A variable part, from the *minerval*,[1] which accrues from equal distribution among the professors [2] of fees paid by the pupils; and (2) a fixed part.

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[1] This term is applied to the fee paid by the pupils for scholastic instruction.

[2] Professors of drawing, gymnastics, and music are excepted.

If the minerval part does not amount to at least 700 francs a year, the State makes up the deficiency. In larger athénées this part of the salary may range from 900 francs to 2,000 francs, or even more.

As to the fixed part of the salary, the initial amount is 2,600 francs. By periodic increments it may reach 5,500 francs in the following manner:

	Francs.		Francs.
Initial salary,	2,600	After 15 years,	4,100
After 3 years,	2,900	After 19 years,	4,500
After 6 years,	3,200	After 23 years,	5,000
After 9 years,	3,500	After 27 years,	5,500
After 12 years,	3,800		

Surveillants commence with a salary of 2,200 francs, but have an increase of 200 francs every three years; the years passed as surveillant or as substitute teacher count in fixing the salary of the teacher, who finally becomes a professor.

In the collèges communaux the initial salary varies from 1,800 to 2,400 francs; the increases vary according to the schools, and the minerval is not distributed among the professors. The years spent in a collège communal are always counted toward promotion when a professor is called to an athénée.

At the head of each athénée is a préfet des études who does not teach and who has been chosen from among the professors, at least 40 years of age, in another establishment. Apart from the variable minerval the salary of a préfet ranges from a minimum of 4,400 francs to a maximum of 5,900 francs; he has also free residence, heat, and light.

The chairs at athénées of large cities are most sought after, because of the higher minerval and the attractions which large centers offer. As a general thing professors of mathematics start in division (A) or in division (D), and after some years pass to division (C) if they have acquired distinction by their professional aptitude and their publications. There is no definite rule concerning advancement, though the rule of seniority is ordinarily respected.

Every professor 60 years of age is retired with a pension. This pension may be obtained when he is 55 years old if he has taught for 30 years, or if he has had to give up work on account of disability. The basis of calculating the pension is the average salary, minerval included, for the last five years of service. The pension is 1/55 of this amount for every year of service, including the four years of study. Thus a professor beginning with any title in secondary-school work at the age of 24, and pensioned at 60 years, counts first 36 years of service, then the 4 years at the university. He has then the right to 40/55 of his average salary, say $(40/55)(5500+700)=(40/55)\times$

6,200, if he has taught in a school of ordinary importance. The pension must not exceed 7,500 francs.

As a rule Belgian professors of mathematics in secondary schools do not find time for scientific research. Those who do promote science by their publications may aspire to university chairs. Such has been the line of advancement of Profs. Neuberg and Fairon to the University of Liege, of Profs. Schoentjes, Servais, and Stuyvaert to the University of Ghent, and of Profs. Donder and Mathy to the University of Brussels.

To prepare *régents* or teachers for the State lower middle schools, the Government has instituted two normal schools at Nivelles and Ghent. Admission is gained (1) by examination, (2) after study in a primary normal school, or (3) after having completed the III or II in an athénée. The course of studies lasts three years. The students who prepare themselves for the scientific examination[1] specialize in mathematical studies in the second and third years. The program of such studies strongly resembles that of the scientific divisions of the athénée, except that the study of spherical trigonometry is replaced by that of mechanics. Pedagogy and methodology are studied in thorough fashion; during their whole course the future régents are required to give practical lessons to pupils of the "école d'application" connected with the normal school, and the final examination calls for two lessons—one in science and one in mathematics. The candidate who has passed all necessary examinations is qualified to become a *professeur agrégé de l'enseignement moyen du degré inferieur* or *régent de l'école moyenne.* Owing to their excessive number, only about one-half of such graduates eventually find a place in a State or communal school. They start ordinarily as *instituteurs* in a primary section connected with the lower middle school, and after a term of years are appointed as professors of lower middle schools. The salary of a régent varies from 2,100 francs to about 4,000 francs. Rectors get from 500 to 800 francs more. The régent is required to teach about 25 hours a week.

The professors in the normal schools are selected from among: (1) Doctors who have completed their university studies; (2) the best of the régents.

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[1] There are three types of courses organized to develop teachers for different groups of studies in the lower middle schools.

BIBLIOGRAPHY.

—DOCK, L. MONTFORT, et H. PLOUMEN, *Rapports sur l'enseignement des mathématiques du dessin et du travail manuel dans les écoles primaires, les écoles normales primaires, les écoles moyennes, les athénées et les collèges Belges.* (Commission internationale de l'enseignement mathématique, sous-commision Belge.) Bruxelles, J. Goemaere, 1911, 348 pp.

The three authors of the four reports which go to make up this volume are, respectively, inspectors of the normal primary schools, of teaching of drawing and design, and of secondary education.

J. ROSE, "La préparation théorique et pratique des professeurs de mathématiques de l'enseignement secondaire en Belgique" *L'Enseignement Mathématique*, tome 18, 1916, pp. 335–352.

This interesting article was written in May, 1916, by an exiled teacher from the Athénée Charleroi.

"Sur l'enseignement des mathématiques en Belgique," *L'Enseignement Mathématique*, tome 12, 1910, pp. 20–36.

IV. DENMARK.

Although Denmark is less than 16,000 square miles in extent, it has a population of close upon 3,000,000 people. Their educational system, which has always been closely associated with the Lutheran Church, ranks high. At present church control is merely nominal, although "both the bishops and clergy serve as members of school committees ex officio, and aid in the selection of teachers and in the administration of the schools." But apart from this the schools are under civil control.

The minister of ecclesiastical affairs and public instruction is at the head of the whole educational system, including the university. In each of the 18 counties of Denmark he delegates certain duties to the school council or *skoleraad;* and to each of 60 districts is given control, within certain limits, of such things as the appointment of teachers, arrangement of courses of study, and selection of texts.

The system of Danish elementary and secondary schools was newly organized by enactments of 1903, which did not come into complete operation until 1910. As one result much greater coordination between the branches of education was brought about. It is now possible to find a connected course leading from the primary schools to the university. Secondary education proper begins in the Mellemskole or middle school, which the pupil may enter at the age of 11 years. The regular course lasts four years.[1] Those who satisfactorily complete this course may pass on to the Gymnasium. Here, as in Sweden, the pupil must elect to follow one of three parallel lines of study which he will pursue during the three years of the course. These lines are: *Mathematics-science,* with neither Latin nor Greek; *modern languages,* with Latin, but no Greek; *ancient languages.* When he completes the work in any one of these sections the pupil, who is then about 18 years of age, presents himself for the "student's examination." A certificate that he has passed this examination is sufficient to admit the student to the university; indeed, the university grants to every such student a "letter of academic citizenship."

In the mathematics-science section of the Gymnasium mathematics is taught for six periods a week during each of the three years, as compared with two periods a week each year in the other sections. The topics taken up are as follows:

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[1] An extra year is added for those who wish to prepare for the Realexamen, which is accepted as an entrance standard for middle professional schools.

In *Arithmetic and Algebra:* General equation of second degree; maxima and minima; infinitely great and infinitely small quantities; symmetric equations; equations of higher degree in two unknowns (it is shown by examples in connection with the solution of such equations that roots may be lost while extraneous roots are introduced); theory of exponents; calculation with irrational quantities; theory and practice of logarithms; arithmetic, geometric and harmonic series; permutations and combinations; binomial theorem with positive index; interest and annuities; complex numbers; prime numbers; proof that a number can be broken up into prime factors in only one way; algebraic equations; the expression of the coefficients in terms of the roots; the cyclotomic equation.

In *Plane Geometry:* Proof of the theorem of proportionality of the sides of two similar triangles; general proof of the theorem on the area of a right triangle; general theory of similitude with applications to simple construction problems; regular polygons; division of circle into 4, 6, 10, and 15 parts and calculation of corresponding chords; length of the circumference of a circle and its arcs; area of a circle and of circular sectors; the trigonometric functions of acute and obtuse angles with simple applications to solution of triangles; application of rectangular coordinates to graphic representation of simple functions (e. g., ax, ax^2, ax^2+bx+c, $a:x$) for special values of the coefficients; various loci involving proportion; harmonic ranges and pencils; applications to construction problems.

In *Trigonometry:* Trigonometric functions of any angles; formulæ for the functions of the sum, or the difference of two angles, and for functions of double and half of an angle; limit of $\frac{\sin x}{x}$ for $x \doteq 0$; solution of simple trigonometric equations; logarithms and solution of triangles.

In *Solid Geometry:* Principal propositions on lines and planes; convex polyhedral angles; the rectangular trihedral and the determination of a point in space by rectangular coordinates; polyhedra with proof that there are not more than five species of regular convex polyhedra and that the tetrahedron, cube, and octahedron exist; cylinder and cone; the fundamental spherical formulæ and their application to the right spherical triangle; congruence, symmetry, and similitude; area of curved surfaces, such as of the cylinder of revolution, cone of revolution, sphere; volumes of prisms, pyramids, truncated pyramids, cones, spheres, and sections of spheres; proof that plane sections of a cone of revolution may be ellipses, hyperbolas, or parabolas. In the instruction especial emphasis is laid on the development of space perception.

In *Analytic Geometry:* Determination of points and curves by rectangular and polar coordinates; the most important formulæ for the equations of the straight line and circle; parabola, ellipse, hyperbola; tangents, normals, asymptotes, diameters.

In addition to these courses one of the following, A or B, is given:

A. Arithmetic and Algebra: Determinants with applications to linear equations; continued fractions with applications to calculation of irrational square roots and to the solution of indeterminate linear equations. *Analytic Geometry:* Discussion of the general equation of the second degree in two variables. *Solid Geometry:* Icosahedron and dodecahedron; representation of a simple polyhedron by orthogonal projection on two planes at right angles; plane sections of these bodies.

B. Infinitesimal Calculus: Infinitesimals; continuous and discontinuous functions; derivatives of x^n (n rational), of trigonometric functions, of sums, products, and quotients, of a function of a function; Rolle's theorem; maxima and minima; Taylor's series for integral functions; definite and indefinite integrals; integration by parts; simple applications to geometry and to physical problems.

MATHEMATICS AT THE UNIVERSITY.

The university course for the scientific training of the teacher in the secondary schools ends with the "Skoleembedsexamen (teachers' examination). According to regulations of 1906, when a candidate presents himself for this examination with either mathematics (or physics) as a major, he must also present as minors astronomy with applied mathematics, and chemistry with physics (or mathematics). The examination consists of two parts. In the second part the examination is on the major only. Before taking this, indeed at the end of the first year, the candidate must pass a university examination, called the "Filosofikum," in logic, elements of the history of philosophy, and psychology.

In the first part of the examination the mathematical subjects are: Analytic geometry of the plane and of space; algebra; differential and integral calculus, including the theory of infinite series; differential equations with a single independent variable; total and linear partial differential equations in three variables; application of analysis to geometry; statics, kinetics, and hydrostatics; advanced portions of gymnasial mathematics from a higher point of view. For astronomy, in connection with applied mathematics are required: Theory of interpolation; facility in numerical calculation, especially in the use of tables and ephemerides, as well as in the numerical solution of equations.

For the second part of the examination with mathematics as major, candidates must be prepared to answer questions in the following: Function theory and elementary number theory; methods of descriptive geometry; projective geometry in synthetic and analytic presentation; more thorough treatment of kinematics and kinetics; special study of some part of mathematics; the history of mathematics (in connection with which the candidate must make himself familiar with Euclid's Elements and Descartes's Geometry),[1] and either with the complete development of a single branch of mathematics or with the whole field of mathematics in a given period.

Both parts of the examinations are oral and written; the oral are public; the written examination of the first part lasts four hours and the special problem of the second part ten hours. The candidates who have passed the Filosofikum and Skoleembedsexamen are called *candidati philosophiae* and *candidati magisterii*, respectively.

The degree of doctor of philosophy may be won by any candidatus magisterii who has received the highest grade and who has prepared a satisfactory thesis which has been printed. Since the degree of doctor gives the jus docendi, the thesis may be regarded as a Habilitationsschrift. Within the past 100 years less than two score of these doctors have been created.

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[1] To every mathematician familiar with Greek mathematics or with the history of mathematics the names of Heiberg and Zeuthen, professors at the University of Copenhagen, are well known. Their influence is doubtless observable in these unusual requirements.

THE TEACHER IN THE SECONDARY SCHOOL.

Since 1908 everyone who has been appointed as teacher in a complete State secondary school is a candidatus magisterii and has had two years of professional training. The first year has been normally spent at the Pedagogic Seminar established in 1906 and maintained by the State. Before entering upon the work of this seminary each candidate must, as a rule, hold a degree from the university. During the first semester he receives theoretical instruction which includes: The history and principles of education and methods of teaching; a study of the development and present organization of Danish education; school hygiene, including the physiology and hygiene of adolescence. Professors of university rank are in charge of the instruction. The examinations covering the work of the course are both written and oral. During the second semester the candidate is occupied in practical work under the direction of the inspector of candidates for teaching positions in gymnasia. He is given special training in the teaching of his two special subjects. At first he listens only, then instructs in the presence of the teacher or the school director or the inspector. The day's work closes with critical discussion. The candidate's work of the semester ends with a preliminary examination which consists of two hours of teaching in his major subject and one in his minor, in the presence of his adviser, the headmaster of the school, and the State inspector of complete secondary schools. After a further year of activity as assistant or regular teacher in a State or private secondary school the candidate must take his final examination.

This form of training may be omitted "if a candidate has worked at least two years at a school and has his skill in teaching tested by an *examenskommission* consisting of three experts appointed by the ministry for that purpose." This last method is followed by most candidates for positions in the secondary schools. The private schools in Denmark, as in Norway, have been the training ground for the teachers in the public schools.

The salaries are low, in general, even for Denmark. The maximum salaries range from 2,400 krone ($646) for assistant teachers to 5,000 krone ($1,346) for principals, but a residence is also provided for the principal.

This sketch may be appropriately concluded by a sample of the examination problems in the *skoleembedsexamen:*

FIRST PART.

I. (4 hours.)

Give a presentation of the theory of pole and polars for the circle $x^2+y^2=r^2$ Determine the geometric locus of the pole of the tangents to an ellipse with respect to a circle whose middle point is a focus of the ellipse.

II. (4 hours.)

(1) Prove that the two infinite series

$$A=\sum_{n=1}^{n=\infty}\frac{1}{n^3(n+1)^3},\quad B=\sum_{n=1}^{n=\infty}\frac{1}{n^2}$$

satisfy the condition $A+6B=10$.

(2) Given that $x\neq 0$ and $a\neq 0$, and $F(x)=x^n+a^n-(x+a)^n$, $f(x)=x^2+ax+a^2$. Prove that $F(x)$ is divisible by $f(x)$ or $(f(x))^2$ according as $n=6m-1$ or $n\neq 6m+1$; m is a positive integer.

(3) Let $f(x)$ be a rational integral function of x, let a and b be constants and $a\neq 0$. Prove that the differential equation

$$(ax+b)\frac{dy}{dx}+\frac{a}{2}y=f(x)$$

has one and only one particular integral which is a rational integral function of x; and give a method for determining this particular integral.

III. (4 hours.)

(1) On the arc of a curve is a fixed point O and any point M. The length of arc $OM=s$ can assume the values from $-a$ to $+a$, and the radius of curvature in M is given by $\rho=\sqrt{a^2-s^2}$. With rectangular coordinate system having origin at O and x-axis coincident with the tangent to the curve at O, find the coordinates of M expressed in terms of the angle between the x-axis and the tangent at M.

(2) Determine the coordinates of the center of gravity of the arc of the catenary (regarded as a material homogeneous line),

$$y=\frac{a}{2}(e^{\frac{x}{a}}+e^{-\frac{x}{a}}),$$

which extends from the intersection with the y-axis to a point with the abscissa x. Show that the center of gravity has the same abscissa as the intersection of the tangents at the ends of the arc, and an ordinate which is half of the ordinate of the point of intersection of the normals at the end points of the arc.

SECOND PART.

I. (4 hours.)

(1) If the power series $\Sigma a_n x^n$ has the radius of convergence $r>0$, the region of convergence of the series $f(x)=\Sigma a_n(x^2+x)^n$ is determined. Seek the nature of convergence of this series and show that the sum of the series for $r>\frac{1}{4}$ satisfies the condition $f(-x-1)=f(x)$, and ascertain the series derived from the identity $(1+2x)^{2\nu}=(1+4(x^2+x))^{\nu}$ in the above form.

(2) The point (1, 1, 1) in trilinear coordinates is projected from the three angular points a, b, and c of the fundamental triangle on the opposite sides to the points p, q, and r. A conic, K_1, is tangent to ac in q and ab in r and cuts pr again in u and pq in v. A second conic K_2 is tangent to ba in r and bc in p and cuts qr again in y, pq in z; x is the point of intersection of the lines uv and yz. What is the geometric locus of x if K_1 and K_2 vary in such a way that v and z are harmonically conjugate to p and q.

ii. (4 hours.)

(1) Given that $|x| \neq 1$, and that the positive integer n increases without limit. Determine the limits of

$$A_n=\frac{1}{n}\log(x^{2n}-1)$$

and

$$B_n=\frac{1}{n}\sum_{p=1}^{p=n-1}\log\left(1-2x\cos\frac{p\pi}{n}+x^2\right),$$

and write the last as a definite integral.

(2) Determine the radius of convergence of the power-series

$$1+\sum_{n=1}^{\infty}\frac{x^n}{\binom{\nu+2n}{n}}$$

and discuss the behavior of the series on the periphery of the circle of convergence. If for special values of ν some of the binomial coefficients in the above series are zero, the corresponding members of the series are to be left out.

(3) Show that $x=3, y=11$ are the only positive integral values of x and y which satisfy the indeterminate equation

$$1+x+x^2+x^3+x^4=y^2.$$

iii. (4 hours.)

A rectangular coordinate system (X, Y, Z) in space is turned with an angular velocity ω about the Z—axis which is vertical. A straight, material, homogeneous rod, whose thickness is neglected, of length $2l$ and mass M, is so placed that its end points a and b move without friction along the X—axis and the Y—axis. At a certain instant a is at the origin and has the velocity $2l\omega$ in the direction of the X—axis, while b has a positive Y—coordinate. Determine the angular velocity of the rod in its relative motion with respect to the system (X, Y, Z) at a given instant; also determine the relative, as well as the absolute motion of the end and of the middle point of the rod. If the system (X, Y, Z) has turned through 45° and is suddenly stopped, the rod will move further, since a and b slide without friction on the X—axis and the Y—axis. Determine the angular velocity of the rod immediately after the impulse.

iv. Course problem (10 hours.)

Discuss figured numbers, especially polygonal numbers and their application to the representation of other numbers.

Heegaard gives a list of works used by candidates in preparing for such examinations.

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P. HEEGAARD, *Der Mathematikunterricht in Dänemark* (I. M. U. K.). København, Gyldendalske Boghandel, 1912. 107 pp.

A. ROHRBERG. *Der Mathematische Unterricht in Dänemark* (Berichte und Mitteilungen veranlasst durch die I. M. U. K., Zweite Folge, I), Leipzig u. Berlin, Teubner, 1915. 8+69 pp.

J. S. THORNTON, *Schools Public and Private in the North of Europe*, London, Board of Education, *Special Reports*, 1907, vol. 17, pp. 66–136.

M. HEGLAND, *The Danish People's High School, including a general Account of the Educational System of Denmark.* (Bureau of Education, Bulletin, 1915, No. 45.) Washington, 1915. 182 pp.

After an elementary school course of eight years, there follows a four-year continuation school preparing for the two-year course in the "people's high school." This school is not properly classed with secondary schools. The normal age of pupils entering it is 18.

V. ENGLAND.

It has been well remarked that—

> few nations show the influence of so many different forces in their educational history as may be recognized in that of England—the church, the state, economic conditions, private enterprise, philanthropic endeavor, educational theories—all have contributed some tradition to what is gradually developing into a well-defined system.

By act of 1899 a central Board of Education was created. This consists of a president and various State representatives, the chancellor of the exchequer, and the secretary of the treasury. The act also provided for a committee of 18 members (15 men and 3 women) to act in an advisory capacity to the board. The number of members in this committee was increased to 21 in 1907.

The board is divided into four departments: (1) Elementary education; (2) higher education;[1] (3) technical education; (4) university education.

SECONDARY SCHOOLS.

The secretary of "higher education" has 3 assistant secretaries and 15 regular district inspectors under him; there are also 27 part-time inspectors.

A secondary school as defined by the board, is a school which—

> offers to each of its pupils a progressive course of instruction (with the requisite organization, curriculum, teaching staff, and equipment) in the subjects necessary to a good general education, upon lines suitable for pupils of an age-range at least as wide as from 12 to 17. This definition, which applies both to those schools recognized for grant[2] and to those which, though not in receipt of grant, are placed by the board on their list of efficient schools,[3] determines the minimum requirements upon which the board must insist.

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[1] The term "higher education" as employed here refers to the work of the secondary schools and of those schools, such as evening schools, which give instruction "higher" than "elementary." *Cf.* note 3, page 78.

[2] To secondary schools that meet certain specified conditions (including the provision for free instruction of a certain number of pupils coming from the elementary schools), annual grants are paid, as follows: For each pupil between 10 and 12 years of age, and who, for two years immediately before entering the secondary school, had attended a public elementary school, £2. For each pupil 12 to 18 years of age, £5. An additional grant of £1 for each pupil 12 to 18 years of age in a school which satisfies the following conditions: (1) Provides for the preliminary education of elementary school teachers as bursars or has a pupil-teacher center forming an integral part of the school; (2) has offered not less than 25 per cent of free places.

Extra grants are made on the basis of certain other considerations. (A. T. Smith, in *Cyclopedia of Education*, edited by Monroe.)

In 1909–10 the grants to secondary schools and for the training of secondary school teachers amounted to £791,250.

[3] On July 31, 1913, there were 1,008 schools on the board of education list of "efficient" secondary schools for boys and girls. At these schools there were, in 1913, 179,058 pupils (boys, about 54 per cent). Of this total more than one-fourth were on the free basis.

Those cardinal subjects which must be taught in every such school are: English language and literature, at least one language other than English, geography, history, mathematics, science, and drawing. All "efficient" schools must be open for inspection by the board at all times.

While the "list" has a positive value as guaranteeing that the schools included in it have been found by the board to be efficient, no conclusions should be drawn from the absence of the name of any particular school. There are many schools of high, indeed of the highest, efficiency which have not applied for inspection, and which are therefore not included in the "list." Such, for example, are the following nine "great public schools," known throughout the world as the schools patronized by rich and noble families, and all founded well over 300 years ago: Winchester (founded in 1384), Eton (1440), Westminster (1560), Rugby (1567), Harrow (1571), Charterhouse (1611), Shrewsbury (1551), which are boarding schools; and the day schools, St. Paul's School (1509) and Merchant Taylors' School (1561).

The authority of the board of education has steadily increased since its creation in 1899. This authority, however, bears no resemblance to that centralized in the French ministry of public instruction.

> It rests upon the voluntary assent of civic or institutional authorities desirous of sharing in the treasury grants or of promoting unity of aim and economy of resources through a national agency. All Government measures are closely scrutinized by local authorities intolerant of any encroachments upon their rights, and are subjects of keen analysis and criticism by the numerous educational associations for which England is noted. Apart from their mastery of professional problems, these associations exercise great influence either by their political affiliations, or by their effective organization of popular opinion.
>
> The educational system, like the national life of England, not only progresses by compromise, but holds to what is enduring by a marvelous system of checks and counter checks.[1]

This must suffice to indicate general relations between the board of education and secondary schools. A wide range of designation is used for these schools—for example, Liverpool Institute, Eton College, and Callington County School—and their organization differs greatly.

In the schools with simpler organization there is usually a six-year course. Corresponding to these years are "Forms" numbered I, II, III, IV, V, and VI, but in this there is great variation of usage. I and II are in the "Junior department;" III–VI in the "Senior department. In large schools where there is more than one class in the same subject the better pupils are often put in one class and the less advanced in another. Furthermore, there is sometimes bifurcation through election on the part of students of the "classical side," with Latin and Greek; as opposed to the "modern side," with French and German. Occasionally one finds the "science side" and the "Woolwich side" (as at Harrow) with emphasis on mathematics and natural science. But no single scheme can be indicated which would give an approximately definite idea of any large group of schools. Some particulars may, however, be given of two "efficient" schools: (1) The Liverpool Institute, with an annual attendance of about 500 boys, and (2) the Bradford Grammar School; and of a certain ideal school.

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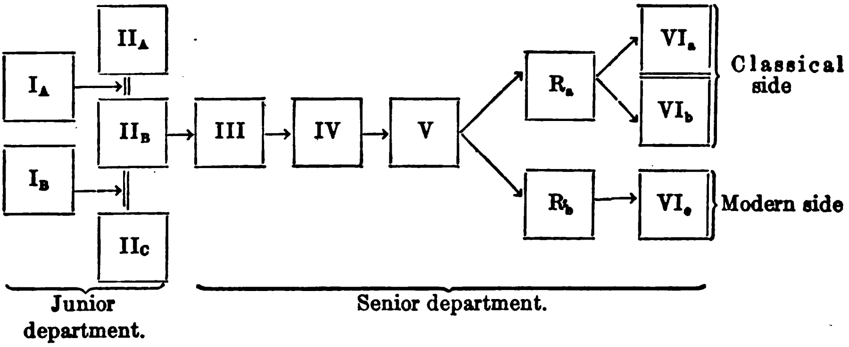
[1] Anna T. Smith, in Monroe's *Cyclopedia of Education*, vol. 2, 1911.

At the Institute the forms may be arranged in schematic array as follows:



We find here after V a "Remove" form (R), often called "Shell." Since I_A and I_B are the same, the better pupils can be put in one group and the less advanced in the other. The subjects studied and the distribution of hours is displayed in the annexed table:

Subjects.	Junior department.					Senior department.							
	I_A	I_B	II_A	II_B	II_C	III	IV	V	R_a	R_b	VI_a	VI_b	VI_c
Scripture	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾
Latin	......	......	3¾	3¾	3¼	3¾	4½	5¼	5¼	......	4½	5¼	......
Greek	......	......	......	......	......	......	......	......	3	......	4½	5¼	......
French	......	......	......	......	......	3¾	3¾	3¾	3¾	3¾	4½	3¾	3¾
German	......	......	......	......	......	......	......	......	......	3¾	4½	......	3¾
Geography	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	......	1½	1½
History	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	2¼	2¼	1½
Literature	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	2¼	2¼	2¼
Composition	1½	1½	¾	1½	1½	¾	¾	¾	¾	¾	¾	¾	¾
Grammar	1½	1½	1½	1½	1½	¾	¾	......	......	......	......	......	......
Reading	2¼	2¼	1½	1½	1½	......	......	......	......	......	......	......	......
Writing and spelling	3¾	3¾	3	3¾	3¾	¾	¾	......	......	......	......	......	......
Mathematics	4½	4½	6¾	5¼	5¼	5¼	6	6¾	6	6	4½	5¼	6¾
Physics	......	......	......	......	......	3	3	3	3	3	4½	......	3
Chemistry	......	......	......	......	......	......	......	......	......	3	4½	......	3
Drawing	1½	1½	1½	1½	1½	1½	1½	1½	......	1½	......	......	......
Workshop	¾	¾	1½	1½	1½	1½	......	......	......	......	......	......	......
Singing	¾	¾	¾	¾	¾	......	......	......	......	......	......	......	......
Drill	¾	¾	¾	¾	¾	¾	¾	¾	......	......	......	......	......
Hours per week	22½	22½	27	27	26½	27	27	27	27	27	(1)	27	27

[1] Each boy's time table in upper sixth is made up to 27 hours by electives.

Norwood and Hope planned courses in ideal schools preparing for business life and for entry into a university.[1] The following is the scheme of work for the latter:

Ideal school scheme of work leading to university matriculation.

Subjects.	Preparatory.		Lower course.				Classical specialists.			Other specialists.		
	Age (about).		Age (about).				Age (about).			Age (about).		
	10	11	12	13	14	15	16	17	18	16	17	18
Religion	[1] 1	1	1	1	1	1	1	1	1	1	1	1
English	6	6	3	3	2	2	3	2	2	3	2	2
Latin			6	6	6	6	15	20	22	3	3	3
Greek					[2] 6	6				[2] 4	4	4
French	6	6	5	5	3	3	3	[3] 3	2	3	3	2
German					[2] 6	6				[2] 4	4	4
History	3	3	2	2	2	2	3	3	3	3	3	3
Geography	2	2	2	2	2	2						
Mathematics	6	6	6	6	5	5	5	3	2	14	16	17
Natural science			[4] 3	3	3	3	2					
Botany and zoology	3	3										
Writing	1	1										
Drawing	2	2	2	2	2	2				1		
Workshop	2	2	2	2								
Class hours per week	32	32	32	32	32	32	32	32	32	32	32	32

[1] Sunday service is also to be attended.
[2] Either Greek or German is selected.
[3] In the upper classes German rather than French is usually elected.
[4] These hours may be divided at will between these subjects.

The other "efficient" school, namely, the Bradford Grammar School, with about 200 pupils, has a somewhat different organization, and its course in mathematics is among the best in England. We have here a "classical side" and a "modern side." In the former the course lasts nine years, in the latter eight. "V" is for the seventh year "classical" and sixth year "modern"; "Remove classical" or "Matriculation" for eighth year "classical"; "Matriculation" or "Remove science and mathematics" for seventh year "modern"; Sixth classical for ninth year "classical" and "Sixth science" or "Sixth mathematical" for eighth year "modern." The following is a synopsis of mathematical work.

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[1] While some schools are especially well equipped to prepare pupils for university matriculation, it should be noted that such preparation is not now unusual in any secondary school, even though there be only an occasional pupil to be so prepared. But under new regulations of the bill not yet an act an attempt is to be made to constitute special departments in the best schools of a district, to which promising boys will be transferred from their own schools. In connection with its discussion of the relations of the secondary school to the university, the board of education laid down the following principles, among others, in 1913:

"The specialization proper to the upper part of a secondary school is to be distinguished from the specialization which is natural and proper to a university, and it is the duty of the board to secure that the higher work done in schools, while constituting a proper preparation for university work, does not anticipate it either in the methods of study or in the nature of the curriculum.

"Candidates for degrees in mathematics or science will from the time they enter the university generally devote the whole of their time to the study of mathematics or of one or more branches of science. While at school their work is not (as too often happens) limited in any way. Those who propose to study natural science should continue to give an adequate amount of time to the study of mathematics, and those who wish to be mathematicians should, similarly, continue to do work (including practical work in the laboratory) at some branch or branches of natural science. The board also consider that those who will afterwards be entirely occupied with mathematical and scientific work should, so long as they are at school, continue to give a substantial amount of time to literary work. A thorough proficiency in the use of the English language and a good acquaintance with other languages will be in later years of greater value to them than the small amount of additional specialized knowledge which, by neglecting those subjects, they might acquire at school. It is, moreover, of great importance that by the continued study of selected masterpieces (whether humanistic or scientific in content) they should train their minds to deal with the more general aspects of human thought."

Preparatory—Arithmetic: Elements.

I—Arithmetic: Use of decimal numbers and fractions; factoring; highest common factor and least common multiple; use of brackets.
  Algebra: Introduction to algebraic symbolism.
  Geometry: Fundamental concepts of geometry, such as line, point, direction, area, triangles, solids. Intuitive and practical introduction.

II—Arithmetic: Repeating numbers; coins, weights, and measures; profit and loss; simple interest.
  Algebra: Very simple equations to fix the idea of algebraic symbolism.
  Geometry: Construction and mensuration of bodies; simple division of bodies.

III—Arithmetic: Ordinary and decimal fractions; rule of three; square root; percentages.
  Algebra: The four fundamental operations with applications; equations of the first degree; graphs.
  Geometry: Angle, triangle, parallels; the simple bodies; exact drawing and measuring; simple exercises.

IV—Arithmetic: Harder problems in fractions; change of ordinary fractions into decimal numbers and conversely; abbreviated calculations with decimal numbers, and simple interest calculation; rebates and discount; logarithms.
  Algebra: Breaking up of sums into factors; simple quadratic equations.
  Geometry: Through propositions on the circle (about equivalent to Books 1–3 of Euclid's Elements).
  Trigonometry: To the solution of right-angled triangles.

V—Arithmetic: Bank, rebate, and discount calculation; stocks and shares; interest and annuities.
  Algebra: Quadratic equations and problems; theory of indices; logarithms; series; permutations and combinations.
  Geometry: To similar figures (Euclid's Elements I–V).
  Trigonometry: Logarithms; measurement of a calculation of heights and distances; solution of triangles.

Matriculation—Arithmetic: General review.
  Algebra: Quadratic equations; arithmetic and geometric series; calculation of roots; proportion.
  Geometry: Through theory of similitude (Euclid's Elements, I–VI).
  Elementary mechanics and hydrostatics.

Remove science and mathematics.
  Algebra: Theory of indices; logarithms; equations; series; graphs.
  Geometry: Through theory of similitude.
  Trigonometry: Solution of triangles; goniometry.
  Mechanics and hydrostatics.

Remove classical.
  Algebra: Fractions; highest common factor; least common multiple; square root; equations of first and second degree; logarithms; proportion; series; graphs.
  Geometry: Through theory of similitude.[1]

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[1] With regard to solid geometry in English secondary school programs, reference may be given to a report in the *Mathematical Gazette*, January, 1914, vol. 7, p. 282.

Sixth mathematics.

Theory of equations; plane trigonometry; statics; dynamics; hydrostatics; synthetic and analytic geometry; modern geometry; differential and integral calculus.[1]

Sixth science.

Trigonometry; statics; dynamics; synthetic and analytic geometry; differential and integral calculus.[1]

But while such extensive mathematical courses as these may be found in secondary schools, there are many schools where the mathematics includes only arithmetic, algebra to "progressions," and geometry equivalent to Books I–IV of Euclid's Elements. In some schools, also, neither the algebra nor the geometry is even so extensive as this. In other schools permutations and the binomial theorem for a positive integral index and the equivalent of Book VI of Euclid's Elements (proportion and similitude) are added; but the last subject,

interesting and important as it is, is too often wholly omitted because it is not included in the syllabus for the London matriculation examination, and therefore is actually discouraged in those schools (still too numerous) where it is regarded as dangerous to go a hair's breadth beyond the examination syllabus. It is similarly discouraged in those schools which use the examination of the Oxford and Cambridge joint board.[2]

The programs of studies in secondary schools are largely determined by the universities. This occurs through the influence not only of matriculation examinations, but also of such examinations as those of "joint boards," of the "Oxford local examinations," and of the "Cambridge local examinations."[3] These latter (local) examinations are of three main types:

1. Preliminary (for pupils 12–14 years of age);
2. Junior or lower (for pupils 14–16 years of age);
3. Senior or school or leaving examinations (for pupils 16–19 years of age).

This scheme of examinations was established well over half a century ago, but not many years had passed before a standard examination corresponding to university matriculation was demanded, and to meet this demand the Oxford and Cambridge joint board was called into existence.

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[1] For an interesting report by C. Godfrey on Calculus in the Public and Secondary Schools of England, see *Mathematical Gazette*, January, 1914, vol. 7, pp. 233-240.

[2] That is, the board of examiners for matriculation into Oxford and Cambridge Universities. A similar board is organized for the Universities of Leeds and Sheffield, Victoria University, and the University of Liverpool. The mathematical requirements here are (the University of Leeds calendar 1913-14, pp. 154-155): "Arithmetic. The elementary geometry of triangles, parallelograms, and circles, and of similar rectilinear figures. Algebra, including quadratic equations, with the arithmetical and geometrical progressions and an elementary treatment of irrational quantities and of proportion."

[3] These examinations under the direction of Oxford and Cambridge Universities are referred to as "local" because they take place at the schools, or other convenient centers, and not at the universities.

This board conducts examinations for three certificates:

1. Lower certificate.
2. School certificate,

and a third certificate to be referred to later.

Corresponding to the matriculation examinations of the University of London[1] are the "responsions" at Oxford and the "previous examination" or "little go" of Cambridge University. Broadly speaking these examinations, the Oxford senior local, the Cambridge senior local, and the Oxford and Cambridge school certificate have the same value. Some characteristics of the mathematical parts of these types of examinations may be noted by studying the papers given in Appendix A. Into these characteristics I shall not go further than to remark that all examinations are written, and successful candidates are rated as "pass" or "honor" (first or second).

Sometimes to attain "honor," questions on "additional mathematics" and of a more difficult nature must be answered.

But there are yet other examinations for which many secondary schools prepare pupils. These are for the entrance scholarship examinations in various universities of the country.

The entrance scholarship examinations at the Oxford and Cambridge colleges are conducted on practically identical systems and differ but slightly in detail. At a rough estimate, the Cambridge colleges award 50 or more scholarships, exhibitions, and sizarships every year for proficiency in mathematics. Their value varies from £30 to £80 per annum. The Oxford colleges annually award for mathematics about 20 scholarships of £80 and 10 exhibitions of from £30 to £60. Most of these are tenable for two years, but they are renewed for one, two, or three more years, subject to satisfactory progress being made. The age limit at the time of examination is 19. The subjects of examination in both universities are: Analytic and synthetic geometry, algebra, trigonometry, differential and integral calculus, and mechanics.

Papers set at Cambridge in 1910 are given in Appendix B of this bulletin.

The preparation for the entrance scholarship examinations is similar to that for the "higher" examinations, the passing of which confers certain rights in university and college. Among such examinations are the Oxford higher local, the Cambridge higher local, and that for the higher certificate of the Oxford and Cambridge schools examination board.[2]

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[1] Examination papers for 1916 are to be found in Appendix A. The following works may be consulted in this connection:

1. *Matriculation mathematics papers.* Being the papers in elementary mathematics set at the matriculation examinations of the University of London for June, 1908, to June, 1915, with full solutions to the papers of June, 1915. (University Tutorial Series.) London, Clive, 1915. 136 pp.
2. *Matriculation model answers: mathematics.* Being the London University matriculation papers in mathematics from January, 1913, to June, 1915. (University Tutorial Series.) London, Clive, 1915. 140 pp.
3. *Matriculation mechanics papers.* Being the London University matriculation papers from September, 1908, to June, 1915, with model solutions to the last paper and additional questions. London, Clive, 1915. 130 pp.

[2] Papers set at these different examinations in 1900 and 1910 are given in Special Reports on Educational Subjects, Board of Education, London, vol. 26, pp. 473–488, 500–518.

In the preceding pages some of the noteworthy features of the relation of secondary schools to the general educational scheme have been described, their wide divergence in ideal and in work has been illustrated, and the nature of mathematical courses taught has been indicated. The prominent rôle played in the school organization by preparation for examinations by various boards of examiners suggests the thought that much of the energy of the teachers and pupils must be unfortunately diverted to attacking certain types of problems and examinations, rather than to developing a mastery of the subject in question. But this evil has been recognized and is being dealt with.[1]

Having now observed what mathematics is taught in secondary schools, we must next consider one of the main features of the preparation of the teacher for his work, namely, his course in one of the universities.

UNIVERSITIES.

The universities of England are situated at Birmingham, Bristol, Cambridge, Durham, Leeds, Liverpool, London, Manchester, Oxford, and Sheffield; there are also university colleges at Newcastle, Nottingham, Reading, and Southampton. All of these institutions, with the exception of those at Oxford, Cambridge, and Durham, receive Government grants. The annual attendance of day students is about 12,000, of students at evening classes about 8,000. In addition to these there are at Oxford in the vicinity of 3,400 students, at Cambridge 3,700.

The organization of such universities as those at Birmingham and Leeds especially reminds one of that at the better American universities. The University of London, long merely an examining and degree-conferring institution, was reconstituted by statutes of 1900 as a teaching university and a federation of 26 colleges and schools giving instruction in arts, law, medicine, theology, science, engineering, economics, and music. Sons of noble and wealthy families who seek a university education usually go to either Oxford or Cambridge. Here one finds many of the most brilliant students of the country, those who have won in competition one of the numerous entrance scholarships. It is especially among graduates of these universities—homes of culture and all that is finest in English life—that teachers for secondary schools are sought. As Cambridge is preeminent in mathematics in England, teachers of this subject are much in demand among "honors" men there.

For definiteness, therefore, I shall confine my brief comment to the Universities of Oxford, Cambridge, and London.

It is well known that Oxford has 21 colleges, each with its own teaching staff of tutors and lecturers; that each student is assigned to one of these colleges and has a tutor to whom he looks for guidance, advice, and inspiration in preparing for the various examinations of his university career; and that this preparation demands a high standard of scholarship. Great stress is laid on ease and facility of expression, on the ability to form independent judgments, on originality. No one can get "first" in the class lists on mere hard work and "grinding," or by a display of erudition and an imposing array of facts. The strain of the examinations, especially in the final honors school, is very severe. At Cambridge the scheme is very similar.

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[1] Compare Mr. Joliffe's paper, especially pp. 270-271.

In all three universities the courses lead normally to a "pass-degree" or an "honors-degree," as bachelor of arts; the pass B. A. is attained three years after matriculation. The principal examinations may be exhibited in the following table:

University examinations.

Examinations.	Oxford.	Cambridge.	London.
Entrance	Responsions	Previous (little-go)	Matriculation (matric.).
Intermediate	Pass moderations (pass mods.) [after 3 terms].		Pass intermediate or Pass preliminary arts [after 1 year].
Pass B. A.	Final pass school (groups) [after 3 years].	Tripos Part I [after 3 years].	Pass final [after 3 years].

Examinations for the honors B. A.

Examinations.	Oxford.	Cambridge.	London.
Entrance	Responsions	Previous (little-go)	Matriculation (matric.).
Intermediate	Honor moderations (honor mods.) [after 5 terms].	Tripos Part I [after 3 years].	Honors intermediate or Honors preliminary arts [after 2 years].
Honors B. A.	Final honor school [after 4 years].	Tripos Part II [after 4 years].	Honors final [after 3 years].

Let us suppose that our student wishes to pursue mathematical studies in the honor school at Oxford. He will be allowed to specialize almost to his heart's content. According to the regulations of 1913, the following is the examination program for the final honor school of mathematics, which is one of nine schools.

Algebra, including the elements of the algebra of quantics; theory of equations; trigonometry, plane and spherical; infinite series and infinite products.

Geometry, pure and analytic, of two and three dimensions.

Differential and integral calculus; differential equations.

The elements of the theory of functions of a complex variable, with applications to the elementary functions and to elliptic functions.

The elements of the calculus of finite differences.

The elements of the calculus of variations.

Statics and dynamics of particles, rigid bodies, and strings; the elements of analytical dynamics; statics of rods slightly bent. Hydrostatics; the elements of hydrodynamics; waves on liquids.

Attractions; theory of potential.

Electrostatics; magnetostatics; steady electric currents (flow in linear circuits, laminæ, and solid bodies).

Electromagnetism (magnetic force due to currents, induction); electrodynamics (mechanical effects of currents); dielectric currents (propagation of plane waves in a homogeneous dielectric).

Vibrations of strings; propagation of sound; vibrations of air in pipes.

The elements of geometrical optics.

Spherical astronomy.

Half of the 10 examinations in this program are in pure and half in applied mathematics. They occupy about 30 hours, on 6 consecutive days.

Oxford concedes that the most talented of English mathematical students usually go to Cambridge. It is not surprising, therefore, that the program for the tripos examination is much more elaborate [1] than even that for honors at Oxford. On the other hand, the mathematical opportunities for the specialist in the University of London are not as numerous as those at Oxford.[2]

But while it is possible that a graduate of one of these universities may have received a very broad training in mathematics, it is also true that he may, at the end of his course, know no more mathematics than are required for responsions, namely: Arithmetic, and either Euclid's Elements, Books I–II, or algebra.

TEACHERS IN SECONDARY SCHOOLS.

The organized training of teachers for English secondary schools is in its infancy and extends at most to a postgraduate year in a university. For nearly a decade the board of education has given financial assistance to institutions training secondary school teachers, but while this feature is being increasingly emphasized, it is nevertheless true that less than 40 per cent of the total number of secondary teachers (of boys and girls) have had some training, and that not more than 15 per cent have been trained for the specific work in which they are now engaged.

According to regulations which went into force in 1913, students may be trained as teachers in secondary schools in (1) training colleges, (2) certain secondary schools.

In order to be recognized as a training college under these regulations—

> an institution must be an institution or a department of an institution organized for the purpose of giving instruction in the principles and practice of teaching specially designed for persons who are preparing to become teachers in secondary schools as defined in the regulations.

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[1] This program is given on pages 194–95 of Special Reports on Educational Subjects, Board of Education, London, vol. 27. The examination papers for Parts I and II of the mathematical tripos are published annually in pamphlet form by the Cambridge University Press.

[2] *Cf.* H. Bateman, "The Work of an English Mathematical Student," *Mathematics Teacher*, vol. 5, 1913, pp. 147–153.

2. The training college course must be confined to purely professional instruction.

4. (*a*) Adequate provision must be made, in secondary schools approved by the board for this purpose, for the instruction and practice of students in teaching and in school organization and management.

(*b*) If the training college is a department of a secondary school, this condition may be satisfied, provided that the student has ample practical experience during the year of training in the school of which the college is a part.

6. The course must extend over not less than a full academic year.

7. At least 60 school days must be spent in contact with class work under proper supervision in schools approved for this purpose by the board. Not less than two-thirds of the teaching practice must be taken in a secondary school or schools.

Training of teachers in secondary schools may be carried on under the following conditions:

21. (*a*) The school must be on the list of secondary schools recognized as efficient by the board.

(*b*) Any person proposed for recognition as a teacher in training must be not less than 21 years of age and must have obtained an approved degree conferred by some university of the United Kingdom or some other university of recognized standing. In the case of a woman who is not eligible to receive a degree, a certificate showing that she has fulfilled all the conditions which entitle a man to obtain an approved degree will be accepted for the purpose of this article.

(*c*) The course followed by a teacher in training must provide for a systematic course of study both in the practice and in the principles of teaching in accordance with a scheme approved by the board. The scheme must provide in each case for a special study of the methods of teaching a particular subject or group of allied subjects.

(*d*) The course must extend over not less than a full school year. The whole year must ordinarily be spent in the school to which the teacher in training is admitted, but arrangements may, in certain cases, be made for the absence of the teacher from the school for part of the year for the purpose of attending a course of instruction in the principles of teaching at a university.

(*e*) A school will only be approved for the purpose of this chapter if the head master or head mistress or some other senior member of the staff is specially qualified and has the necessary interest and leisure to supervise the teacher's training.

22. When a teacher in training has been trained for a year in an approved school under conditions which the board can regard as satisfactory, the board will indorse a certificate given by the head master or head mistress of the school stating that the teacher has completed the period of training in a satisfactory manner.

The regulations give also a "List of qualifications other than degrees which will be accepted as qualifying students for admission to training colleges." These are:

I. A tripos certificate granted by the University of Cambridge to women, provided that the examination taken was one which, if passed by a man after three years' residence, would entitle him to a degree without further examination. Women students who have been allowed the ordinary degree in a tripos examination will be regarded as possessing the necessary qualification.

II. A diploma or certificate showing to the satisfaction of the board that the applicant, if a woman, has fulfilled all the conditions which, if the University of Oxford granted degrees to women, would entitle her to a degree in that university; so that she has obtained honors in the second public examination or has passed the first and second public examination[1] at that university or such examinations as are accepted by the university as equivalent thereto.

III. A special honors certificate of the higher local examinations (Oxford and Cambridge) granted under the following conditions:

(a) That the certificate includes at least a pass in two languages (other than English) and a pass either in mathematics or in logic; and

(b) That the holder either (i) has passed in four groups or sections, obtaining a first or a second class in at least two of them; or (ii) has passed in three groups of sections, obtaining a first or a second class in at least two of them, and holds in addition (1) an Oxford or a Cambridge senior local certificate in honors, including at least one subject not included in the three higher local groups or sections, or (2) a higher certificate of the Oxford and Cambridge schools examination board, gained in one year, exclusive of drawing and music, and including at least one subject not included in the three higher local groups or sections.

Among the institutions recognized as efficient under regulations of the board of education for the training of teachers for secondary schools are: (1) Departments controlled by, or forming part of, a university or university college; (2) training colleges provided by other bodies. Departments of the first type are to be found at Birmingham University, Durham University—Armstrong College, Leeds University, Liverpool University, London University, Victoria University, Oxford University delegacy for the training of secondary teachers, and Reading University College. An example of a training college of the second type is the Clapham High School, in London.

To illustrate the methods of operation, some details follow with regard to organization in units of each of these types. For the most part the statements have been made by the institutions in question.

(a) *University of Liverpool.*—It is little more than a decade ago that a diploma in education for graduates, along the present lines, was established. The courses of study qualifying for the diploma were placed under the control of a special board, in organic relation to the faculties of arts and science, and including persons representing secondary education in the city.

Candidates for the diploma must be graduates of some university in the United Kingdom, or have obtained such other academic qualifications as shall be approved by the senate of the university. Before admission to the examination candidates present certificates of (1) having fulfilled the conditions as to practical teaching, and (2) having attended for at least one session[2] subsequent to their final examination for a degree a course of study approved by the diploma board.

The diploma examination consists of two parts, theory and practice. Candidates are required to pass written examinations in the following subjects:

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[1] First public examination—moderations after 3 semesters; second public examination—examination for the degree.

[2] One session consists of 3 terms of about 10 weeks each.

1. Logic, ethics, and psychology, including psychophysiology, in their application to education.
2. Principles of education, with special reference to methods of teaching the usual subjects of the secondary school curriculum; principles of general physiology and school hygiene.
3. A prescribed period of the history of educational theory and practice.

In respect to practice, candidates are judged (1) upon reports by the professor of education, and (2) upon written records of their work in school and upon their teaching before the examiners. Candidates are required to attend at approved practicing schools for a period of at least 250 hours. They are, as a rule, attached to one school throughout the session, and, so far as possible, they undertake work such as would be allotted to a member of the staff. They also attend lessons given by members of the school staff and study the methods of teaching the special subjects in which they are interested. The general supervision of their work is in the hands of the university staff, but each student is also under the direction of one teacher, who reports on his progress. The students are required to keep a record of teaching observed and of courses of lessons given, to be submitted to the examiners.

The fee for the complete course is £10 and the examination fee is £2 additional.

(b) *Clapham High School.*—The department for the training of teachers for secondary schools was opened in 1902. Students desiring to enter must possess a degree, or equivalent qualification, or hold a higher local honor certificate.

Throughout the course students follow lessons given in the school by experienced teachers. They themselves also teach, under supervision, which is relaxed as they gain experience and power. They learn the various duties of a form teacher by being sent as assistants in a form, for not less than half a term at a time. Visits are paid to other schools of different types, and students give criticized lessons in outside schools. Lessons are followed by general discussion, with the specialist in charge of the subject.

The course covers three terms, and the plan of study includes instruction in the theory of education, based on psychology, logic, ethics, and the history and practice of education. Instruction is also given in the use of the blackboard, voice production, and school hygiene.

The fee for the course is £24.

Such organizations give promise of a more efficient group of secondary teachers in the near future. Not so long ago—

> of the 9,126 full-time teachers [men and women] in secondary schools which received grants from the board of education, 5,348 were without professional training. Of this

group of untrained teachers, 2,731 were also without degrees from college or university. The total number of secondary teachers without degrees was 3,715.

It appears that very few secondary teachers appointed in the last decade have not had the equivalent of a university course supplemented by practical training. But even so, it is noteworthy that a university graduate may be engaged to teach a subject about which he has not increased his knowledge since he left the secondary school. As Mr. Fletcher comments: It is "a matter of grave concern that half of our mathematical teachers of boys and girls have had no instruction in mathematics beyond what they have had at school."

If we consider only the best grade of secondary schools for boys, the scholastic equipment of the teachers in the subjects taught ranks high, the work that the teachers do is characterized by great thoroughness, and their personal influence is such as to inspire the finest ideals of manhood.

I have been unable to procure any comprehensive statement of salaries paid to teachers in English secondary schools. But even if such a statement has not been published, enough has come from authoritative sources to demonstrate the wide variation in salaries and, in most instances, their great inadequacy. The serious effect of this condition on the personnel of the teaching forces is now generally recognized, and it is hoped that through the authority of the board of education much needed reform in this connection may be brought about.

In August, 1900, Dr. W. H. D. Rouse, headmaster of the Perse School, published some striking facts which would seem to give a true presentment of general conditions at the time.[1] He found that the average salary of assistant masters in 300 schools mentioned in the returns of the Charity Commission was £135.22, and that a similar average for 20 East Anglian schools was £103.6.

> In 11 smaller schools the average salary is £52, and these data combined give a sum just below £120 as the average salary of the assistant. Residence, i. e., board and lodging, is included in some cases; but we may leave this out of account, because it is payment for extra work done out of school. The Victorian public schools, such as Clifton, Cheltenham, and Marlborough, and others which though noted in the past are of late growth, such as Tonbridge and Bedford, are not included in the above list, which is meant to illustrate the usual condition of country grammar schools. If these be included, the average will be slightly raised. At Cheltenham there are one or two posts at about £300, one at least of £100 only, and the others range from £200 to £250 as a rule. Clifton and Marlborough do not greatly differ. The state of things in Bedford is thus described by one who knows: "There is no scheme of salaries in either of the two big schools. *Each man fights for what he can get;* if he makes a good bargain to start with, well for him." A few years ago the average salary at Bedford Grammar School was £174, but many form masters received £150 or less, some under £100, all these being nonresident. At Tonbridge there is in my table only one salary higher than £200. There is usually no automatic increase. If a master wishes to

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[1] "Salaries in Secondary Schools," *Contemporary Review*, vol. 78, pp. 275-280.

marry or thinks his increased experience makes his services more valuable, he may have to get another post (if he can) in another school. As to the smaller schools, the account of the career of a Cambridge B. A. of my acquaintance may be of interest. He began in Andover Grammar School at £15, resident, and after several moves from one private school to another, where the pittance was somewhat increased, he attained, after nine years' experience, to the magnificent stipend of £140, nonresident, in the grammar school of a country town which for his sake I forbear to mention. A London B. A., whose life story is also before me, now receives £130, nonresident, after 18 years' experience. The same pitiful story comes from scores of small country schools.

The headmasters' salaries present a pleasing contrast. In the best-paid of the schools mentioned, Tonbridge, the headmaster receives £5,000 and upward, while his assistants have less than £200. The usual average is ten times that of the assistant, falling to five times in the East Anglian schools and even occasionally to less. So far as my knowledge goes (and as regards some of these schools it is not negative knowledge), neither headmaster nor governing body has expressed any dissatisfaction with the state of affairs or has ever considered means whereby the salaries of assistants might be permanently improved. The chance of succeeding to a boarding house keeps hope alive in some schools, and this rather than the earned reward of merit would seem to be the present educational ideal.

The following definite indications of salaries in four types of secondary schools were taken by Norwood and Hope in 1909 (pp. 567–568) from a list issued by the assistant masters' association:

A. LONDON SCHOOLS.
  1. *City of London School.*
    (*a*) Upper scale, £300, rising to £450 by annual increments of £5 15s. 4d.
    (*b*) Lower scale, £200, rising to £350 by same increments. Five masters are paid on the higher scale and 15 on the lower.
  2. *Mercers' School.*
    (*a*) Upper scale, £160, rising to £300.
    (*b*) Lower scale, £120, rising to £200.

B. PROVINCIAL SCHOOLS.
  1. *Manchester Grammar School.*
    Ordinary scale, £180, rising by £20 every two years to £300.
  2. *King Edward VII School, Sheffield.*
    (*a*) Five masters, £220 to £250, rising by £10 annually to £300.
    (*b*) Five masters, £180 to £200, rising by £10 annually to £250.
    (*c*) Five masters, £150, rising by £10 annually to £200.

C. MUNICIPAL SECONDARY SCHOOLS.
  1. *Bournemouth.*
    £120, rising to £150, with three special salaries of £170, rising to £250; £160, rising to £200; £140, rising to £170.
  2. *Hartlepool.*
    £150, rising to £200.

D. COUNTRY AUTHORITIES.
  1. *London County Council.*
    £150, rising by annual increments of £10 to £300, on satisfactory reports, with further annual increments of £10 to £350
  2. *Surrey.*
    Nongraduates, £100, rising by annual increments of £5 to £150.
    Graduates, £130, rising by annual increments of £7 10s. to £250.

Provision for the pensioning of teachers in secondary schools is certainly meager.

A number of wealthy endowed secondary schools have for some time had individual pension systems of their own, operating under provisions of their respective schemes of government of charters, most of which were received under the endowed schools acts for England beginning in 1869. * * *. Also in a few cases secondary teachers in schools under public management have been pensioned by local authorities. With these exceptions there has been nothing remotely approaching any general provision of pensions for secondary teachers.

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VI. FINLAND.

The area of Finland is somewhat less than half that of Texas, and its population is but slightly in excess of 3,000,000; yet it publishes many important periodicals and is the home of not a few learned societies. Of the inhabitants, about 80 per cent are Finns and about 11 per cent Swedes.

By ordinances of 1869 and 1872 the general administration of the national system of primary education, as well as that of the secondary schools which heretofore had been under ecclesiastical direction, was vested in a central board or council of education. The members of this council are appointed by the senate (constituted by imperial appointment), upon the nomination of the Diet (legislative assembly). The executive chief of the system, the director general, is also appointed by the senate. An assistant director has charge of primary education, and there are Government inspectors for both secondary and primary schools.

Those State secondary schools which have interest for us are the lyceer (classical and real), each with an eight years' course. In the real, as compared with classical lyceum, one additional hour per week is spent on mathematics, and greater emphasis is laid on physics. Such lyceer prepare directly for the university.

There is no examination in passing from one class to another in the lyceum. But after finishing the work of the VIII class, the pupils, who are about 17 years of age, are required to submit to both written and oral tests. The written tests are the same throughout the country and occur on the same days. They consist of (1) a composition written in the mother tongue; (2) an examination in the other language, Finnish in a Swedish school, Swedish in a Finnish school; (3) a Latin translation in the classical lyceer, a French, German, or Russian in the real; (4) a test in mathematics. In connection with (4), questions are also given on physics. The test lasts for six hours, and the pupil who answers at least three questions, out of about ten, in a manner satisfactory to the professors in the school, is declared admissible. The paper is then submitted to the examination commission of the university, who pass upon it finally. The successful pupils who have also passed the oral test, given by the professors of the university, on all the subjects of the course, receive a "leaving certificate." This certificate now admits the student to the university.

THE ALEXANDER UNIVERSITY.

As experience has shown that the course of mathematics in many lyceer of the country has not been thorough, on account of the great amount of time taken up with languages, the university undertakes to review and complete certain parts, especially in trigonometry. Then follows a course in analytic geometry, which deals with the conic sections and surfaces of the second degree. Only the elements of projective geometry are taught. The text is the manual of analytic geometry, by L. Lindelöf.

Spherical trigonometry is taught in connection with analytic geometry of space. It is taken up more in detail in the courses on spherical astronomy.

Differential and integral calculus is begun in the first year at the same time as analytic geometry, and its study is carried on for two years. The texts of L. Kiepert and E. Czuber are the ones most in demand.

An elementary course in differential equations is frequently given. It contains special geometric applications of the theory. Sometimes developments lead to such problems as the conduction of heat and other questions in the domain of mathematical physics.

Algebra and the theory of numbers are given in the second year. The pupils use G. Bauer's *Vorlesungen über Algebra* as a manual.

Then, further, a course on analytic functions, which takes account of the methods of exposition of Cauchy, Riemann, and Weierstrass, is given every year. H. Burkhardt's *Algebraische Analysis und Einführung in die Theorie der analytischen Funktionen* is recommended for the students.

Besides the above-mentioned regular courses, there are frequently given special courses in certain domains of mathematics, such as minimal surfaces, application of the theory of groups to the resolution of algebraic equations, elliptic functions.

The teaching in the sections "historico-philologique" and "physico-mathématique" of the faculty of philosophy is organized in such a way that the students can, in general, after four or five years of study, pass the necessary examination to obtain the degree of "candidate of philosophy."

This examination comprises, apart from a written test in a modern language, interrogation bearing on at least four of the sciences in the domain of the faculty in question, the combination of subjects being submitted by the candidate and approved by the section. In each subject the successful candidate obtains a predicate—*approbatur*, *approbatur cum laude*, or *laudatur*—these predicates depending on the extent of the program studied. To pass, the candidate must receive either the predicate laudatur in two subjects, or laudatur in one and approbatur cum laude in two others. In addition to this, an essential part of the examination is a study pro gradu. In this paper, which requires a long time to prepare, the candidate treats, in a personal way, some scientific question given or approved by a professor.

To obtain the highest predicate in mathematics in this examination, it is necessary to know thoroughly the courses in analytic geometry, differential and integral calculus with its applications to geometry, differential equations, algebra and theory of numbers, and the theory of functions. For the predicate approbatur cum laude, the theory of functions disappears from the program, and only the first principles of algebra and the theory of differential equations are required. The program for the predicate approbatur is confined to plane trigonometry, plane analytic geometry, and the fundamental notions of the differential and integral calculus.

The candidate who has obtained the degree of "candidate of philosophy" can obtain the degree of licentiate in the faculty of philosophy by continuing his studies, publishing and publicly sustaining a thesis, and passing an oral examination, in which he shows thorough knowledge in three subjects within the domain of the faculty.

The candidate of philosophy receives at the annual promotion the title of master in arts; under the same conditions the licencié may receive the title doctor in philosophy.

In order to be competent to fill a post in secondary teaching, it is necessary to have passed the examination for a "candidate of philosophy" or the examination for the "certificate of aptitude in teaching." This latter examination is passed at the university. It differs from the first only in that it is not absolutely necessary to obtain the highest predicate in one of the subjects. Nearly all candidates become "candidates of philosophy."

NORMAL LYCEER.

The professional education of the professors in secondary schools is concentrated in two normal lyceer, one for professors in Finnish schools, the other for the Swedish. These two lyceer are under the special control of the professor of pedagogy in the university. In order to be inscribed as "stagiaire ordinaire" in a normal lyceum it is necessary to have a "certificate of aptitude in teaching" or to be a "candidate of philosophy." As a general rule, the mathematical candidates have passed the second of these examinations and have obtained the highest or the next to the highest grade in this subject. They are placed under the immediate direction of the senior professor of mathematics.

The extent of training at the normal lyceer is two semesters. The "stagiaire" is thoroughly drilled in the theory and practice of pedagogy. Under the surveillance of the senior professor he teaches in a State lyceum. When his major is in mathematics, he also gives instruction in physics and chemistry.

In addition to work of this kind, candidates are assembled in conferences of three types, monthly, general, and weekly. The monthly conferences are presided over by the professor of pedagogy; ordinarily, the class examines some one pedagogic work each semester. Each of the "stagiaires" in turn makes a report on a part of this work, which at the hour of the conference is the basis for discussion. The portions of the work which concern mathematics are assigned to mathematical candidates. In the general conferences questions of general pedagogy are discussed. The weekly conferences are either the conferences of the candidates in a special subject or those related to it, or special conferences arranged by the senior professors for the individuals. In the mathematical section a mathematical work is generally examined in a manner similar to that obtaining in the monthly conferences.

The "condition of competence" required to obtain a post as professor is that the candidates possess the degree of "candidate of philosophy" with the highest grade in the major subjects required by the post. For the position as "chargé de cours" the same degree or the "certificate of aptitude," with at least the second highest grade in the major subjects required by the position, is necessary. For both classes of teachers an examination in pedagogy and a test in practical pedagogy are required. These tests are conducted by a council of the senior professors of the lyceum, Finnish or Swedish, as the case may be. This council consists of five members; the rector of the normal lyceum, the senior professors of the subject in question from the two normal lyceer, and two members of the council of the normal lyceum where the candidate is being tested. The candidate is invited to teach in assigned classes for the purpose of showing his aptitude for the career which he wishes to embrace. On the basis of this test is given the grade *approbatur*, *approbatur cum laude* or *laudatur*, according to the work done.

CONCLUDING REMARKS.

About one-half of the students in the faculty of philosophy at the university look forward to a career in connection with secondary education. Nevertheless, the professional education of such teachers has been conducted almost wholly by those outside the university. Some slight departure from this policy with regard to mathematics was made in 1912, when an associate professor of mathematics in the university was appointed to a recently created chair. The special task of this professor is "to give courses and direct the practical exercises for the future professors of mathematics in the secondary schools."

Among topics which this professor takes up are:

In *geometry:* The axioms of Euclidean geometry; the principles of projective geometry; a sketch of the various systems of geometry; a systematic exposition of the elementary methods of resolution of geometric problems; the history of elementary geometry.

In *trigonometry:* The historical development of the science.

In *arithmetic:* Methods of numerical calculation; the historical development of elementary arithmetic; the extension of the idea of number.

In *algebra* and the *theory of numbers:* The notion of divisibility in the theory of numbers and in algebra; the historical development of algebra and abridged notation; the application of algebra to the resolution of problems in geometric constructions with the aid of various instruments.

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VII. FRANCE.

Few countries in the world can compare with France in the high standards maintained with regard to the appointment of teachers of mathematics for the secondary schools. One may almost say that the educational scheme in France is largely organized with reference to the preparation and selection of secondary school teachers. It is important therefore to have this general scheme in mind.

For educational purposes France is divided geographically into arrondissements. The assemblage of Government schools (primary, secondary, and superior) in each arrondissement forms an académie over which a recteur presides. There are thus the 16 académies of Aix-Marseilles, Besançon, Bordeaux, Caen, Chambery, Clermont, Dijon, Grenoble, Lille, Lyon, Montpellier, Nancy, Paris, Poitiers, Rennes, Toulouse, as well as a seventeenth at Algiers. With the exception of Chambery, these names correspond to the seats of the French universities.

The assemblage of académies constitutes the Université de France, at the head of which is the minister of public instruction, who is ex officio the "Recteur de l'Académie de Paris et Grand Maître de l'Université de Paris." For the Académie de Paris there is a vice recteur whose duties are the same as those of the recteurs of other académies. Although nominally lower in rank than the heads of académies in the Provinces, he is in reality the most powerful official in the educational system. Since the position of the minister of public instruction is so insecure by reason of changing governments, continuity of scheme is assured by three lieutenants who have charge respectively of the primary, secondary, and superior education. They in turn have an army of inspectors who report on the work and capabilities of the recteurs and their académies as far as primary and secondary instruction are concerned.

The present system of secondary education in France dates from the great reform of 1902 (important modifications were introduced in 1905, 1909, and 1913 [1]) and is carried on for the most part in lycées and collèges communaux, which are to be found in nearly all cities. Because of their preeminence we shall consider the teachers in the former only, which are under control of the State. Here the boys who come from families in comfortable circumstances may enter at the age of 5 or 6 years and be led along in their studies till they receive the baccalauréat at the age of 16 or 17. Many lycées have still more advanced courses to prepare for entrance into such schools as the École Normale Supérieure, École Polytechnique, École Centrale, École Navale, or École de Saint Cyr. For our purpose it is desirable to consider these advanced courses and the students who, having taken them, enter the École Normale Supérieure.

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[1] Rept. of Commis. Educ., 1911-12, vol. 1, Washington, 1913, pp. 528-532.

Instruction in fully equipped lycées may be divided into four sections: (1) Primary, five years, for children from 5 to 10 years of age; followed by (2) first cycle, four years, the first section of the secondary education, properly speaking; which leads to (3) second cycle, three years, on the completion of which the student receives the State degree known as the baccalauréat. In about one-third of the 120 lycées in France there are also (4) the classes de mathématiques spéciales. In considering the training of teachers for the lycées certain general facts with regard to (2) and (3) should be borne in mind, while detailed information as to (4) is essential.

Since the reforms of a decade or so ago the pupils of the first cycle are divided into two groups. In the one are those who learn Latin, with or without Greek, and in the other are those who have nothing to do with a dead language. Pupils of the latter group go into the science-modern languages section of the second cycle. Into this section may also enter certain pupils who give up the study of Latin to specialize in modern languages and science. But in the second cycle there are three other sections entitled, "Latin-science," "Latin-modern languages," and "Latin-Greek." The work in mathematics is decidedly heavier in the science sections, and as this work must be taken by all prospective teachers of mathematics, we may confine our attention to these sections. The classes of these sections in the successive years are named as follows:

Classes of the sections.

	First year.	Second year.	Third year.
Latin-science	Seconde C	Première C	Mathématiques A.
Science-languages	Seconde D	Première D	Mathématiques B.

The work in mathematics is the same throughout in both sections.

At the end of the second year the first of the examinations for the baccalauréat are taken. They are both written and oral and of an elaborate and exacting nature. Among the examiners, six in number, in a given arrondissement, three are professors from the university. Under similar conditions the second and final tests are applied at the end of the third year[1] and the successful pupil becomes a

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[1] E. LORMEAU ET P. MERLET, *Problèmes de géométrie donnés aux examen du baccalauréat Latin-Science, Sciences-langues, Mathématiques A* (*1904–1908*) *énoncés dans la géométrie André et Lormeau.* Énoncés et Solutions. Paris, André-Guédon, [1909].

bachelier. Little, if any, exaggeration is made by regarding the bachelier as upon a plane of scholastic equality with the student who has finished the sophomore year at one of the best American universities. Several of France's most brilliant mathematicians and teachers of our day became bacheliers when only 16 or 17 years of age.

If the bachelier who is proficient in mathematics be not turned aside by circumstances or inclination to seek immediately a career in civil or Government employment, he is likely to proceed to prepare himself for the highly special and exacting examination necessary for entrance into one of the great schools of the Government. The method of this preparation exhibits a very peculiar feature of the French system. Whereas with us, or with the Germans, the boy who has finished his regular course in the secondary school goes directly to some department of a university for his next instruction, the bachelier, who has a perfect right to follow the same course, returns to this old lycée (or enrolls himself at one of the great Paris lycées, such as St. Louis, Louis le Grand, or Henri IV), to enter the classe de mathématiques spéciales préparatoires which leads up to the classe de mathématiques spéciales. The latter is exactly adapted to prepare students for the École Normale Supérieure, the École Polytechnique, and the bourses de licence. As mentioned above only a small proportion of the lycées have this classe, but with the exception of Aix they are to be found in all university towns. On the other hand, still other lycées have classes which prepare specially for the less exacting mathematical entrance examinations of the École Centrale, École de St. Cyr, École Navale, etc. But the number of pupils who on first starting out deliberately try to pass examinations for these schools is small in proportion to the number who eventually reach them after repeated but vain effort to get into the École Polytechnique or the École Normale Supérieure. Just what makes these two schools famous and peculiarly attractive will appear later. When the pupil has won his baccalauréat he may immediately matriculate into a university, and although it might be possible for him to keep pace with the courses, it would be, in mathematics at least, a matter of excessive difficulty. There is then in reality, between the baccalauréat and the first courses of the universities, a distinct break, bridged only by the classes de mathématiques spéciales.[1]

The élèves who enter the preparatory section of this class are, generally, bacheliers leaving the classes de mathématiques. Natural science, history and geography, philosophy—indeed practically every study except those necessary for the end in view—have been dropped, and from this time on to the agrégation and doctorat, all energies are bent in the direction of intense specialization. This is the most pronounced characteristic of French education to-day. In mathematics, instruction now occupies 12 instead of 8 hours per week. New points of view, new topics and broader general principles, are developed in algebra and analysis, trigonometry, analytic geometry, and mechanics. Physics and chemistry are taught during 6 hours instead of 5. Add to these, German, 2 hours; French literature, 1 hour; descriptive geometry, 4 hours; drawing, 4 hours. After one year of this preparatory training the élève passes into the remarkable classe de mathématiques spéciales.

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[1] It is only for mathematical or scientific students that such a break occurs, as no special classes are provided in other subjects except in the case of half a dozen Paris lycées which have classes in "letters" preparatory for entry into the École Normale Supérieure.

Eight years of strenuous training have made this class possible for the young man of 17 or 18 years of age, who is confronted with no less than 34 hours of class and laboratory work per week and no limit as to the number of hours expected in preparing for the classes. The program seems a well-nigh impossible performance for one year. Surely no other country can show anything to compare with it.

It would be interesting to consider fully the mathematical program as given at the end of the plan d'étude, but I shall hastily refer to only a few of the subjects treated. In *algebra and analysis* we find developed the fundamental ideas concerning irrational numbers, convergency and divergency of series, the elements of the theory of functions of a real variable, power series, their multiplication and division, their differentiation and integration term by term, Taylor's formula, the theory of algebraic equations, including symmetric functions, but omitting the discussion of infinite roots. The latter part of the course treats of differentiation of functions of several variables, elementary ideas concerning definite integrals, integration of such functions as are considered in a first calculus course of the best American colleges, rectification of curves, calculation of volumes, plane areas, moments of inertia, centers of gravity, differential equations of the first order, solutions of simpler differential equations of the second order which occur in connection with problems of mechanics and physics. Whenever possible in the discussion of these topics the power to work numerical examples is emphasized.

Plane trigonometry and the discussion of spherical trigonometry through the law of cosines are treated in class, and five-place tables are used.

In the course on *analytic geometry* there is given a thorough discussion of equations of the second degree, of homography and anharmonic ratios as they enter into the discussion of curves and surfaces of the second degree, of points at infinity, asymptotes, foci, trilinear coordinates, curvature, concavity and convexity, envelopes, evolutes. The professor also discusses thoroughly the various questions connected with the treatment of quadric surfaces and less completely, the theory of surfaces in general, of space curves, osculating planes, curvature of surfaces. The elements of the theory of unicursal curves and surfaces and of anallagmatic curves and surfaces are also taken up.

So also, we find broadly arranged programs in mechanics and descriptive geometry. The whole number of class hours per week is broken up as follows:

> Mathematics, 15; physics, 7 (2 in laboratory); chemistry, 2; descriptive geometry, 4; drawing, 4; German, 2; French, 1. The scope of the mathematical work may be judged from some books which were prepared with the needs of such a class especially in view: B. Niewenglowski, *Cours d'algèbre*, I, 382 pp.; II, 508 pp.; supplement—G. Papelier *Précis de géométrie analytique*, 696 pp.—Girod, *Trigonométrie*, 495 pp.—P. Appell, *Cours de mécanique*, 650 pp.—X. Antomari, *Cours de géométrie descriptive*, 619 pp.

If anything, this list underestimates the work actually covered[1] by those who finally go out from the class. Tannery's *Leçons d algèbre et d'analyse* (I, 423 pp.; II, 636 pp.), might well replace Niewenglowski's work; while Niewenglowski's *Cours de géométrie analytique* (I, 483 pp.; II, 292 pp.; III, 569 pp.) represents the standard almost as nearly as Papelier's volume. Another treatise on mechanics widely used is that of Humbert and Antomari.

When we further realize that the main parts of the books in this list, which represents the work for only one of a half dozen courses, are covered by the professor in about 15 months—the last three months of the second year are given over to drill in review and detail—we begin to get some conception of what the classe de mathématiques spéciales really stands for. In his instruction the professor is officially "recommended"—

> not to overload the courses, to make considerable use of books, not to abuse general theories, to expound no theory without numerous applications dealt with in detail, to commence invariably with the more simple cases, those most easy to understand, leading up finally to the general theorems. Among the applications of mathematical theory, those which present themselves in mathematical physics should be given the preference, those which the young people will meet later in the course of their studies either theoretical or practical. Thus, in the construction of curves, choose as examples those curves which present themselves in physics and mechanics, as the curves of Van der Waals, the cycloid, the catenary, etc.—in the theory of envelopes choose those examples of envelopes which are met in the theory of cylindrical gearing—and so on. The pupils should be trained to reason directly on the particular cases and not to apply the formulæ. To sum up, the aim should be to develop the pupil's judgment and initiative, not his memory.

The success of a class is, by happy arrangement, not left to depend wholly upon a single man. Take, for example, lycée St. Louis in Paris. It is the greatest preparatory school for the École Normale Supérieure and the École Polytechnique. There are four classes de mathématiques spéciales, and for all the members of these classes, conferences, interrogations, and individual examination are organized. These exercises, which are complementary to the daily instruction, are conducted by one of the professors in the lycée, or by one of another lycée, or by one of those from the Collège de France, the Sorbonne, the École Polytechnique, or the École Normale. Incapable students are thus speedily weeded out, a marked solidity of the training is attained and, perhaps most valuable of all, the interest of the pupil is sustained at a high pitch.

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[1] That is, much more than what is called for by examination questions is studied. The students find truth in the adage: *Qui peut le plus peut le moins.*

With the end of the year the pupil has his first experience of a concours or competitive examination. Previously he has found that it was necessary only to make a certain percentage in order to mount to the next stage in his scholastic career; but now it is quite different. In 1908, 1,078 pupils tried for admission to the École Polytechnique, but only 200, or 19.5 per cent, were received; for the department of science in the École Normale Supérieure, 22 out of 274, or 8 per cent, succeeded. In each case the number was fixed in advance by the Government according to the capacity of the school; the fortunate ones were those who stood highest in the examinations, written and oral. In the case of the École Polytechnique, the written examinations were held in all the lycées which had a classe de mathématiques spéciales. The 387 candidates declared "admissible" were then examined orally at Paris, and from them the 200 were chosen. Similarly for the École Normale, the written examinations are conducted at the seats of the various académies and the oral at Paris. Since 1904 the concours passed by students wishing to enter the École Normale has been that for the stipends known as bourses de licence,[1] open to candidates of at least 18 years of age and not more than 24. Certain dispensations in the matter of age are sometimes granted. The value of the bourse, for the section of science, is from 600 to 1,200 francs a year and is intended to help the students to prepare for the licence and other examinations required of prospective professors in the lycées and universities. The candidates leading the list in the concours are sent to the École Normale Supérieure for from three to four years. It is necessary for the six or seven other boursiers to prepare for future examinations at the various universities of the Provinces. Their bourses last regularly for two, and exceptionally for three, years.

But to return to the students of the classes de mathématiques spéciales. At the end of the first year, when 18 or 19 years old, they usually present themselves for the concours of both the bourse de licence and the École Polytechnique, the examinations in the former being more strenuous and searching. Only from 2 to 5 per cent succeed on the first trial. The others then go back to the lycée and take another year in the classes de mathématiques spéciales. Many points not fully understood before are now clear, and at the end of the second year from 25 to 28 per cent are successful. The persevering of those who fail again return to their classe and try still a third time (the last permitted for the bourse de licence); but it is a matter of record that less than one-half of those who enter the classe de mathématiques spéciales succeed even with three trials. This is usually the last trial possible for entry into the École Polytechnique, as the young man who has passed the age of 21 on the 1st of January preceding the concours may not present himself. The remainder of the students either seek for entrance into Government schools with less severe admission requirements, and thus give up their aspirations to become mathematicians, or else continue their studies at the Sorbonne or other university. The candidate who heads the list in each of these concours has his name widely published. In the case of the bourse de licence he is called the *cacique*, and he very frequently tops also the École Polytechnique list.

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[1] The mathematical questions at the concours of 1913 are given in Appendix C.

If the work in the classe de mathématiques spéciales is so enormously difficult[1] that only 2 to 5 per cent of its members can, at the end of one year, meet the standard of requirements of the examinations for which it prepares, why is not the instruction spread over two? Since nearly all the mathematical savants who now shed luster on France's fair fame have passed from this remarkable class on the first trial, there can be no doubt that the answer to this question may be found in the fact that the French Government ever seeks her servants among the élite of the nation's intellectuals.

Those who pass from the classe de mathématiques spéciales at the early age of 18 years are not numerous, but Borel and Picard are such men, while Goursat entered the École Normale Supérieure at 17 years of age. For the average boy the lycée course is heavy, and more than once he may have to halt in order to repeat a year. The system of training is largely formulated to develop to the full the powers of the brilliant boy and to promote his rapid advancement. For such youths poverty is no deterrent. Every lycée has a number of bursaries (covering all expenses) which it distributes to just such boys coming with distinguished records from the primary schools. If the boy's record is sustained, renewal of his bursary from year to year is assured.

There has been occasion to point out the strong influence which the École Normale Supérieure and École Polytechnique exert on the careers of the flower of the French youth; how that instead of entering the university on passing the baccalauréat, as in America or in Germany—

they seek to enter these schools. The reason for this is not difficult to find. The École Polytechnique which prepares its pupils as military and naval engineers,

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Cf. P. Appell, "Sur la classe de mathématiques spéciales," *L'Enseignement mathématiques*, vol. 2, 1900, pp. 340–346.

artillery officers, civil engineers in Government employ, telegraphists and officials of the Government tobacco manufactories, offers all of its graduates a career which is at once rapid, brilliant, and certain. The École Normale practically assures its graduates at least a professorship in a lycée and prepares its students for this or for a university career, better and more rapidly than the university can do it.

Let us suppose that our future mathematical professor in the lycée is one of the 11 mathematical students who is successful in getting into the École Normale in a given year. He studies there for three years and receives special drill in pedagogy; simultaneously he also hears courses of lectures at the Sorbonne[1] and at the Collège de France.[2] Almost the whole purpose of the drill and instruction is to prepare for two examinations, the licence and the agrégation.

The diploma *Licence ès Sciences*, which is necessary for all those who take up secondary teaching, is granted to those who have three "certificats" in any one of three groups of subjects. Our mathematician is examined in the following subjects: (1) Differential and integral calculus; (2) rational mechanics; (3) general physics or some advanced topic in mathematics. The examinations may be taken singly in July or in November; each examination successfully passed entitles the student to a certificat for that subject. The examination consists of three parts, *épreuve écrite*, *épreuve pratique*, *épreuve orale*. The first two are written examinations of about four hours each. Theoretic considerations abound in the écrite, while numerical calculation is characteristic of the pratique. The oral lasts for 15 to 20 minutes and is held before a jury of those professors who have the whole examination in charge. The pass mark is 50 per cent.

To understand just what is implied in the possession of the diploma, *Licence ès Science*, let us consider the value of such a certificat as that in differential and integral calculus. To prepare for the examination in this subject at the Sorbonne (and the methods at other universities in France are little different) the candidate attends three courses during the preceding year. The first of these consists of about 60 lectures of 70 minutes each on differential and integral calculus by Goursat; in the second, 30 lectures of one hour each on applications of analysis to geometry are given by another professor; the third course is made up of 60 lectures of about 70 minutes each on problems illustrative of the above 100 lectures. In this way practically all of the first volume and a portion of the second volume of Goursat's *Cours d'analyse mathématique* is discussed. Upon this work the examination for the first certificat is based. In a similar way there are three courses each in preparation for the examinations to secure the certificats in rational mechanics and general physics. There is probably no graduate school in America where the student attains such a comprehensive grasp and mastery of these subjects.

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[1] The Sorbonne is the name of a building in the University of Paris where the instruction in science and letters is given.

[2] The Collège de France, founded in the sixteenth century, is independent of the general educational scheme but ranks higher than any of the universities. Two or three courses in pure and applied mathematics are offered each year. In them the lecturers usually set forth original developments of the subjects.

Unlike the baccalauréat and the licence, the agrégation is a competitive examination and is conducted by the State. The number who become agrégés each year is fixed in advance by the minister of public instruction according to the needs of the lycées in the country. This number in recent years has been about 14; the number of candidates is usually about 80. Our candidate for this examination must have four certificats: (1) Differential and integral calculus; (2) rational mechanics; (3) general physics; and (4) a subject chosen at pleasure in the advanced mathematical fields in which courses are offered.

To pass the agrégation our future professor disposes of his three years as follows: During each of the first two years he passes the examinations for two of the four certificats. With these successfully taken he turns his whole attention to preparing for the agrégation proper. This examination is unique in its difficulty and exactions. As it is organized for selecting the most efficient young men in the country to take charge of the mathematical classes in the lycées, the examination turns largely on the subjects there taught. It consists of *épreuves préparatoires* and *épreuves definitives*. The former are four written examinations, each of seven consecutive hours in length (7 a. m. to 2. p. m.). The first two of these are on subjects chosen from the program of the lycée in mathématiques élémentaires and mathématiques spéciales. The last two, based on the work of the candidates in the universities, are a composition on analysis and its geometric applications and a composition on rational mechanics.[1] The épreuves are held at the seats of the various académies of France. Those who have reached a sufficiently high standard are declared "admissible." Their number is usually a little less than twice the possible number to be finally received. They must present themselves at Paris for the épreuves definitives. These consists of two written examinations and two leçons or specimens of class-room instruction. The written tests are an épreuve de géométrie descriptive, and a calcul numérique. Their duration is fixed by the jury, but it is usually four hours for each. A leçon is supposed to be the treatment of some topic such as a professor might give (during three-fourths to one hour) in a lycée. The subjects are drawn by lot and are taken from the programs of the following classes: (*a*) Mathématiques spéciales; (*b*) Seconde, Première C, D, and Mathématiques A, B. For each lesson the candidate has four hours to think over what he is going to say. No help from book or other source is permitted. The unfortunate who has little to say is speedily "adjourned."

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[1] Copies of examination questions and of the program of a concours may be consulted in Appendix D.

The agrégés are those specially prepared by the State for the positions of professeurs titulaires in the lycées. Although this title is not conferred regularly till the agrégé has completed his twenty-fifth year, those who are younger receive temporary appointment, for every agrégé may demand a position as his right. The salaries vary according to the "classe" of the professor. At Paris the lowest salary is 6,000 francs per year, and the highest, 9,500. In this range seven classes are represented; six, each differing from the one before by 500 francs, and the hors classe, for which the salary is 9,500 francs. Promotion from one class to another takes place by selection and by seniority. From the sixth (the lowest classe) to the third, the number of those who can be advanced each year by selection is equal to the number which can be advanced by seniority. In the second and first classes two advancements may be made by selection to one by seniority. Those named for the hors classe are advanced by selection alone. The promotions are made at the end of each calendar year, and take place so that there are always 20 per cent of them in the sixth classe, 18 in the fifth, 18 in the fourth, 16 in the third, 14 in the second, and 14 in the first. This arrangement is obviously a happy one, both by way of recognition of the merits of the unusually successful teacher, as well as those of one whose service is rather characterized by faithfulness.

In addition to the professeurs titulaires there are professeurs chargé de cours, who are usually selected from those who have been students at the École Normale and those admissible to the agrégation, who fail to become agrégés. After 20 years of service they may become professeurs titulaires and receive the salaries we have indicated above. The Government has, however, recently passed a law which gives a higher reward to the agrégé. It is to the effect that 500 francs per year shall be added to the regular salary of every agrégé. The real range of salaries mentioned above is, then, 6,500 to 10,000 francs; in the provinces this reduces to 4,700 to 6,700. For the professeurs chargés de cours the salaries at Paris vary from 4,500 to 6,000 francs; in the provinces, from 3,200 to 5,200.[1] In the premier cycle the professors have 12 hours of teaching per week, in the second cycle and classe de mathématiques spéciales, 14 to 15 hours. Except for correcting exercises and filling out reports, the professors have absolutely no obligations outside of class hours. They do not live in the lycées. The superintendence of the study of the pupils is carried on by repetiteurs, the more advanced of whom receive at Paris 2,600 to 4,600 francs for 36 hours' service per week.

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[1] The tendency of recent legislation is to exclude from the lycées all professors who are not agrégés.

Attractions connected with a professorship in a lycée[1] are that the remuneration is ample to live on comfortably, that the work is not onerous and often quite decidedly inspiring, that colleagues are brilliant specialists in the same or other lines of study, that the professorships are positions of honor and prominence in the community, and that the incumbents are in demand in many ways which frequently materially increase their regular income. In general the charge of the classe de mathématiques spéciale, enrolling in its membership the pick of the French youth of mathematical bent, is confided only to a professor in the first or hors classe, but to this position all may aspire.

With inducements such as these it causes no surprise to learn that France draws to the development of her system of secondary education much of the best mathematical talent in the country.

BIBLIOGRAPHY.

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For information concerning the scheme of secondary education, and of mathematical work in particular, the inquirer should turn to *Plan d'études et programmes d'enseignement dans les lycées et collèges de garçons* (Paris, Delalain, 1910).

A very valuable general work by several different authors is *Secondary and University Education in France.* London, Board of Education, Special Reports, vol. 24, 1911. 554 pp.

Other references are given in my papers: (1) "Mathematical Instruction in France" (*Transactions and Proceedings of the Royal Society of Canada* for 1910, IV, 89–152); (2) "Mathematical Instruction and the Professors of Mathematics in the French Lycées for Boys" (*School Science and Mathematics*, 1913, XIII, 43–56; 105–117).

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[1] In normal times men only are allowed to teach in lycées for boys, but 104 women were employed in 1915 in such lycées and 293 in the collèges. (Rept. of U. S. Commis. of Educ., 1916, vol. 1, Washington, 1916, p. 591.)

VIII. GERMANY.

In 1913 Germany or the German Empire was third among European countries in area and second in population, being next after Russia and Austria-Hungary in area, and second only to Russia in population. Politically the Empire is composed of 26 States and divisions: The four Kingdoms—Prussia, Bavaria, Saxony, and Wurttemberg; six Grand Duchies, the largest of which are Baden and Mecklenburg-Schwerin; five Duchies, of which the largest is that of Brunswick; seven Principalities; the three free towns of Lubeck, Bremen, and Hamburg; and the Imperial Territory, Alsace-Lorraine, which is about the same size as the Grand Duchy of Baden. The Kingdoms embrace more than four-fifths the area of the Empire, which is upward of 208,000 square miles. Prussia alone exceeds three-fifths, and its population of approximately 40,000,000 people is but little less than two-thirds that of the Empire.

There is no such centralization of education in Germany as in France. The only point of direct contact between the Empire and education lies in—

> the mutual undertaking of the federated States to bring the law of compulsory attendance to bear upon all subjects of the Empire resident within their respective borders. Of far greater moment is the moral influence exerted upon the other States by the Prussian hegemony, in virtue of which the Prussian educational system comes to be in all essential characteristics typical and representative of Germany as a whole.

In Prussia the highest educational authority is the minister of spiritual and educational affairs,[1] who is appointed by the King. He is usually a jurist by profession and represents his department in the Prussian Parliament.

> His individual obligations are numerous. He has charge of the financial affairs of his own department; appoints, with the approval of the Crown, counselors and other officials; confers titles upon teachers, ratifies their appointments, and makes promotions, except when this right has been granted to other authorities; and he is the court of final appeal in all matters connected with this branch of government.[2]

The ministry of spiritual and educational affairs is organized into departments of ecclesiastical affairs and education. The direction of the department of education devolves upon under-secretaries, who are the minister's deputies, associated with 30 to 35 special counselors; 10 or 15 assistants are also attached to the department. It consists of two main divisions: The one which "has charge of common schools, normal schools, high schools for girls, and institutions for the education of defective children"; the other which exercises supervision of higher education, including universities [1] and secondary schools.

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[1] Formerly this officer was minister of religious, educational, and medicinal affairs, but in 1911 the department of public health was organized as a separate body. The demand for a separate ministry of education is insistent.

[2] J. E. Russell, *German Higher Schools*, new edition, New York, 1907, p. 112. I have been more than once indebted to this very interesting and valuable work.

The immediate administration and supervision of secondary education in each of the 13 Provinces of Prussia is delegated to a provincial school board,[2] which is composed of four or five counselors selected by the minister from among directors of training colleges and Gymnasien. The provincial Ober-Präsident is chairman of the board by virtue of his office.

Among other duties prescribed for the board are:

> The establishment of regulations for conducting final examinations (Maturitätsprüfungen or Reifeprüfungen) and revision of reports of the same.
>
> Inspection, revision, and direction of the reports of those higher schools[3] which admit to the university.
>
> Appointment, dismissal, suspension, and discipline of higher-school teachers (not directors).

SECONDARY SCHOOLS.

The official classification of secondary schools in Prussia is in accordance with the curricula, and the following types are recognized: I. Classical schools: (*a*) Gymnasium, with nine years' course; (*b*) Progymnasium, with six years' course. II. Modern schools: (*a*) With Latin but without Greek (semiclassical)—(i) Realgymnasium (nine years' course), (ii) Realprogymnasium (six years' course); (*b*) without Latin or Greek (nonclassical)—(i) Oberrealschule (nine years' course), (ii) Realschule (six years' course).

The three leading types of secondary schools are: Gymnasium, Realgymnasium, and Oberrealschule. The following are the names of the classes and their abbreviated forms:

Lower stage:		Upper stage:	
Sexta	VI	Obersekunda	O II or II A.
Quinta	V	Unterprima	U I or I B.
Quarta	IV	Oberprima	O I or I A.
Intermediate stage:			
Untertertia	U III or III B		
Obertertia	O III or III A		
Untersekunda	U II or II B		

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[1] In Prussia there are 10 universities, namely, those at Berlin, Bonn, Breslau, Gottingen, Greifswald, Halle, Kiel, Konigsberg, Marburg, and Munster; in the whole Empire there are 21. The others are situated in the Kingdom of Bavaria, at Erlangen, Munich, and Wurzburg; in Saxony, at Leipzig; in Wurttemberg, at Tubingen; in the Grand Duchy of Baden, at Freiburg and Heidelberg; in the Grand Duchy of Hesse, at Giessen; in the Grand Duchy of Mecklenburg-Schwerin, at Rostock; in the Grand Duchy of Saxe-Weimar, at Jena; and at Strassburg, in Alsace. The university at Frankfort, Hesse, was opened in the autumn of 1914.

[2] Provinzialschulkollegium.

[3] In Germany secondary schools are called "higher" schools (higher than the elementary schools), and institutions of university rank are called "high" schools.

The schools with six-year courses lack the "upper stage" and are usually found in cities unable to support the full course.[1]

Pupils usually enter all of these schools at the minimum age of 9 and spend one year in each class, although some, requiring more time to complete the work, remain longer. To enter a Gymnasium the pupil must have had a three years' preparatory course in reading, writing, arithmetic, and religion. This course may be obtained in the elementary public or private schools, or in the special Vorschulen connected with the Gymnasium. These are preferred by the wealthier classes.[2]

The Gymnasium is a classical stronghold; French is the required modern language, English being an optional subject. About one-half of the 304 lesson hours in a week[3] of the course in the Gymnasium are devoted to linguistic study. Apart from cultural development, the course is intended to prepare students for university specialization in either arts or sciences.

The aim of the Realgymnasium is "to give the youth a liberal education founded especially on instruction in the modern languages, mathematics, and the natural sciences." English takes the place of Greek in the Gymnasium program, and more time is devoted to French and natural sciences.

In the Realschule and Oberrealschule the pupils receive broad preparation for business careers. With this end in view the study of modern languages and of the natural sciences is emphasized.

To formulate more definitely our conceptions of Prussian ideals in standard secondary schools, it will be well to consider the program of the official Lehrplan. While certain optional studies are offered, only exceptional students attempt them, as the regular work is extremely heavy. From IV on, in all of the schemes, music is demanded only of pupils with real ability. The bracketed numbers in two of the tables indicate when hours may be differently distributed.

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[1] One reason for the success of the six-year schools has been that boys who graduate from them are granted the much prized "privilege of serving only one year in the army and of entering upon the career of an officer in case they choose the army as a profession." Another reason is that large business houses and banks frequently recruit their apprentices from such graduates.

[2] In the public elementary schools (öffentliche Volksschulen) the course is usually laid out for eight years, and attendance of all children is compulsory from the ages of 6 to 14, unless a child attends some other school or receives private instruction. The Volksschulen are designed to train good citizens, while the Vorschulen and Gymnasien impart instruction with a view to preparing men of education and culture. The cleavage between Volksschulen and "higher schools" has been much criticised, as it is "founded wholly upon a basis of wealth. The child who passes his tenth year in a Volksschule where tuition is free, instead of a Gymnasium or Realschule where a tuition fee of from $30 to $50 is charged, finds himself, as a rule, permanently entered upon a career in which university attendance, preparation for a liberal profession, or qualification for any of the higher governmental positions is definitely prohibited." (See W. S. Learned, "An American Teacher's Year in a Prussian Gymnasium." A Report to the Carnegie Foundation for the Advancement of Teaching. *Educational Review*, 1911, p. 369.)

[3] A lesson hour contains about 47 minutes. Classes occur on 6 days of the week, and the school year lasts about 40 weeks.

Gymnasium.

Subjects.	VI	V	IV	U III	O III	U II	O II	U I	O I	Total.
REQUIRED.										
Religion	3	2	2	2	2	2	2	2	2	19
German	4	3	3	2	2	3	3	3	3	26
Latin	8	8	8	8	8	7	7	7	7	68
Greek	.....	.....	.....	6	6	6	6	6	6	36
French	.....	.....	4	2	2	3	3	3	3	20
History	.....	.....	2	2	2	2	3	3	3	17
Geography	2	2	2	1	1	1	....	....	....	9
Arithmetic, algebra, geometry, and trigonometry	4	4	4	3	3	4	4	4	4	34
Natural science	2	2	2	2	2	2	2	2	2	18
Writing	2	2	.....	.....	.....	.....	.....	.....	.....	4
Drawing	.....	2	2	2	2	.....	.....	.....	.....	8
Gymnastics	3	3	3	3	3	3	3	3	3	27
Music	2	2	2	2	2	2	2	2	2	18
Total	30	30	34	35	35	35	35	35	35	304
OPTIONAL.										
Drawing	.....	.....	.....	.....	.....	2	2	2	2	......
Hebrew	.....	.....	.....	.....	.....	.....	2	2	2	......
English	.....	.....	.....	.....	.....	.....	2	2	2	......

Realgymnasium.

Subjects.	VI	V	IV	U III	O III	U II	O II	U I	O I	Total.
REQUIRED.										
Religion	3	2	2	2	2	2	2	2	2	19
German	4	3	3	3	3	3	3	3	3	28
Latin	8	8	7	5	5	4	4	4	4	49
French	.....	.....	5	4	4	4	4	4	4	29
English	.....	.....	.....	3	3	3	3	3	3	18
History	.....	.....	2	2	2	2	3	3	3	17
Geography	2	2	2	2	2	1	.....	.....	.....	11
Arithmetic, algebra, geometry, and trigonometry	4	4	4	5	5	5	5	5	5	42
Natural science	2	2	2	2	2	4	5	5	5	29
Writing	2	2	.....	.....	.....	.....	.....	.....	.....	4
Drawing	.....	2	2	2	2	2	2	2	2	16
Gymnastics	3	3	3	3	3	3	3	3	3	27
Singing	2	2	2	2	2	2	2	2	2	18
Total	30	30	34	35	35	35	36	36	36	307
OPTIONAL.										
Geometrical drawing	.....	.....	.....	.....	.....	2	2	2	2	......

Oberrealschule.

Subjects.	VI	V	IV	U III	O III	U II	O II	U I	O I	Total.
REQUIRED.										
Religion	3	2	2	2	2	2	2	2	2	19
German	5	4	4	3	3	3	4	4	4	34
French	6	6	6	6	6	5	4	4	4	47
English	.....	.....	.....	5	4	4	4	4	4	25
History	.....	.....	3	2	2	2	3	3	3	18
Geography	2	2	2	2	2	1	1	1	1	14
Arithmetic, algebra, geometry, and trigonometry	5	5	6	6	5	5	5	5	5	47
Natural science	2	2	2	2	4	6	6	6	6	36
Writing	2	2	2	.....	.....	.....	.....	.....	.....	6
Freehand drawing	.....	2	2	2	2	2	2	2	2	16
Gymnastics	3	3	3	3	3	3	3	3	3	27
Singing	2	2	2	2	2	2	2	2	2	18
Total	30	30	34	35	35	35	36	36	36	307
OPTIONAL.										
Geometrical drawing	.....	.....	.....	.....	.....	2	2	2	2	......

Percentage of time spent on different subjects in the typical schools.

Subjects.	Gymnasium.	Realgymnasium.	Oberrealschule.	Subjects.	Gymnasium.	Realgymnasium.	Oberrealschule.
Religion	6.2	6.2	6.2	Mathematics	11.2	13.7	15.3
German	8.5	9.1	11.1	Science	6.0	9.4	11.8
Ancient languages	34.2	16.0	....	Writing	1.3	1.3	2.0
Modern languages	6.6	15.3	23.5	Drawing	2.6	5.2	5.2
History	5.6	5.5	5.8	Gymnastics	8.9	8.8	8.8
Geography	3.0	3.6	4.5	Singing	5.9	5.9	5.8

The extent to which these different type schools appeal to the Prussians appears from the following statistics:

Number of schools and of pupils.

Classes of schools.	Number of schools.		Number of pupils.	
	Feb. 1, 1909.	Feb. 1, 1912.	Feb. 1, 1909.	Feb. 1, 1912.
Gymnasien	336	342	102,297	103,314
Realgymnasien	138	168	41,202	50,319
Oberrealschulen	85	102	34,735	41,986
Progymnasien	35	30	4,497	3,787
Realprogymnasien	45	44	4,878	4,346
Realschulen	169	177	33,350	32,421

These figures show that for the three-year period 1909–1912 there was little change in the number of Gymnasien and of pupils attending them, while the increase in this respect in connection with Realgymnasien and Oberrealschulen was very striking. There seems little reason to doubt that these schools will outnumber the Gymnasien in the not very distant future. For more than a century the Gymnasien have been the "center and strength of the German school system; and while schools of different nature have been established with a view to modern economic needs, popular prejudice is so strong that only graduates of the Gymnasien are regarded as cultured."

In 1901 it was enacted that those who are "ripe," that is, those who have passed the Reifeprüfungen of the Gymnasien, Realgymnasien, and Oberrealschulen should be admitted to practically equal privileges, with respect to both civil-service preferment and university matriculation. So far as our future teacher of mathematics is concerned, he may have entered the university from any one of the higher schools, but if he had any teachers of Latin and Greek in the secondary schools they must have experienced their fundamental training in Gymnasien. The Reifeprüfung also gives the right of admission to the technical Hochschulen, to the careers of officer in the army and navy, and, ultimately, to State examinations at the end of a university or technical course. Indeed, it is almost the only entrance "to all higher positions of honor and trust in the service of the State; and social recognition in which it is held is correspondingly high."

To obtain a clearer idea of the early mathematical training the future teacher has received, as well as better to appreciate the relation between the teacher's work and his professional training, let us briefly consider the mathematical content of Prussia's secondary-school courses as well as the nature of the emphasis in their presentation.

On entering Sexta at nine years of age the boy is supposed to have the ability to add, subtract, multiply, and divide simple whole numbers. The general scheme of the programs of the Realgymnasien and Oberrealschulen is as follows:

VI (four or five hours, weekly): *Arithmetic*, fundamental operations with whole numbers; weights, measures, and currency; simple tasks in decimal fractions.

V (four or five hours): *Arithmetic*, common and decimal fractions; rule of three. *Geometry*, propaedeutic, "enough to get the pupils looking at things from a geometric point of view."

IV (four or six hours): *Arithmetic*, rule of three problems in calculation of profit and loss, interest, discount. *Geometry*, lines and angles; theory of triangles and quadrilaterals. *Algebra*, propaedeutic.

U III (five or six hours): *Arithmetic*, commercial. *Algebra*, reckoning with abstract quantities; proportion; equations of the first degree with one unknown quantity. *Geometry*, theory of quadrilaterals; circle and area; constructions.

O III (five hours): *Algebra*, theory of powers and roots; equations of the first degree in several unknowns; simple equations of the second degree in one unknown. *Geometry*, proportion; theory of similitude; the length of a circumference.

U II (five hours): *Algebra*, logarithms; equations of the second degree; graphs. Elements of *trigonometry*. Elements of *solid geometry* of plane and line; mensuration; oblique parallel projection.

O II (five hours): *Algebra*, arithmetic and geometric progressions; compound interest and annuities; imaginary quantities; reciprocal and binomial equations, harder quadratic equations. *Geometry*, harmonic ranges and pencils; radical axes; centers of similitude; power, poles, and polars of circles. Systematic treatment of *solid geometry*. Conclusion of plane *trigonometry*.

O I (five hours) and U I (five hours): *Algebra*, permutations and combinations, with applications to the theory of probabilities; binomial theorem for any exponent; the most important series, exponential, logarithmic, sine, cosine, and arithmetic series of second order; cubic equations; maxima and minima. *Descriptive geometry. Geometrical conics. Analytic geometry*, conic sections. *Spherical trigonometry*, with applications to mathematical geography and spherical astronomy.

It is only in a general way that such a synopsis as the above conveys a definite idea; this can be more adequately derived from consulting some such texts as those of Heis, and Koppe-Diekmann.[1] The

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[1] E. Heis: *Sammlung von Beispielen und Aufgaben aus der allgemeinen Arithmetik und Algebra*, Köln, 1837. Over 300,000 copies of this famous book have been sold; the one hundred and eleventh edition was published in 1912. Koppe-Diekmann's *Geometrie zum Gebrauche an höheren Unterrichtsanstalten* (21. Auflage) 3 Teile. Ausgabe für Reallehranstalten 5. Auflage der neuen Bearbeitung von J. Diekmann. Essen, 1903. There is probably a later edition, but this is the last I happen to have. Plane and solid geometry, plane and spherical trigonometry, geometrical conics, and analytic geometry are all treated in this single work.

See also W. Lietzmann, *Stoff und Methode der Raumlehreunterrichts in Deutschland* (IMUK, Band V, Heft 2), Leipzig, 1912. 8+88 pp.; B. Hoffmann, *Mathematische Himmelskunde und niedere Geodäsie an den* following official "Notes on method" are also instructive.[2]

1. In the higher schools the chief object of the mathematical instruction is to provide such a training of the intellect as will enable the pupil to apply correctly in independent work the ideas and knowledge which he has gained. Therefore in all the various divisions of this branch the aim must be to secure a clear comprehension of the propositions to be developed and of their proof, as well as practice and skill in their application. Accordingly, the teacher of mathematics, equally with the teacher of any other branch, is urged to use every opportunity to foster a proper use of the mother tongue, and this point is most particularly to be remembered in the correction of written work, especially of more independent work done at home, which in the upper classes is to be done, as a rule, every four weeks, in addition to the usual class exercises.

2. The instruction in geometry begins with a preparatory course, which, starting with the consideration of simple bodies, develops the power of observation and at the same time gives the pupil opportunities for gaining practice in the use of compasses and ruler.

3. In all schools the most careful attention is to be given to practice in problems of construction, and this practice must accompany the instruction up to the highest classes; but any problem must be excluded which demands for its solution a knowledge of remote principles or special skill in execution. By means of a reasonable selection of exercises, which may be solved by common methods and out of the materials already at the pupil's command, and through the clearness of his instruction, the teacher must awaken in his pupils a feeling of independent capacity and use to the full the formative force of such exercises.

4. The omission of a preparatory course in trigonometry and solid geometry in IIb of the Gymnasium does not preclude that, when these branches are taken up at the later stages, the first instruction should not be of such an introductory character. Trigonometry is to be treated at first by means of figures, that is, geometrically; and, in order to reach as soon as possible the solution of triangles, only such formulæ are to be practiced as are absolutely required for this purpose. Solid geometry is to begin with the consideration of simple bodies (e. g., cubes and prisms), and a more strictly systematic instruction is not to be given till later. In modern schools such introductory courses in trigonometry and solid geometry must be exclusively and under all circumstances followed. Here, as in the earlier stages, models and mathematical wall charts will prove of great assistance in securing proper visualization and thoroughness of instruction.

5. For the highest class of the Gymnasium the program prescribes the introduction of the pupils to the important theory of coordinates and the simplest presentation possible of the fundamental properties of conic sections, which can also be given synthetically. But it is not intended that systematic instruction in analytical or the so-called new geometry should be given. Equally little do the formulæ necessary to understand mathematical geography and astronomy call for any extended treatment of spherical trigonometry. They may be simply deduced from a consideration of the properties of solid angles. Here, too, as elsewhere, care must be taken that, side by side with such knowledge, skill in its application is acquired, and this point of view must determine the selection and the extent of the material of instruction.

6. The defect of the mathematical instruction in the upper stage—viz, that it is too exclusively of the nature of calculation—will be best remedied by practice in geometrical observation and construction. In solid geometry (quite apart from the

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höheren Schulen. (IMUK, Band III, Heft 4), Leipzig, 1912. 6+68 pp.; and P. Zühlke, *Der Unterricht im Linearzeichnen und in der darstellenden Geometrie an den deutschen Realanstalten* (IMUK, Band III, Heft 3), Leipzig, 1911. 2+92 pp.

[2] *Centralblatt für die gesamte Unterrichts-Verwaltung in Preussen*, June-July, 1901. See also Special Reports on Educational Subjects, vol. 9 (London, 1902), p. 201f.

> question of descriptive geometry) it is specially important to prepare and assist the pupil to understand the principles of projective drawing.
>
> 7. In the highest class, side by side with the solution of problems in the different branches of mathematics, there must be a comprehensive review of the theories and processes already learned. An opportunity will thereby present itself of giving to the pupils a fuller understanding of the theory of functions with which they have become acquainted at a previous stage.
>
> 8. The independent position which mathematics occupies in the curriculum of the higher schools does not prevent—least of all in the upper stage—the instruction from gaining in value, if the pupil learns how the results of this science may be applied to other branches of knowledge, whether they be those of everyday life or physical science, and if opportunity be given for the development of his mathematical sense by practice in application in these directions. Accordingly, it is permissible to to make a more extended use of those parts of physics which admit of mathematical treatment, not only in the physics lesson, but also in the mathematical instruction. In the Gymnasium, it is true, owing to the small number of hours allotted to the branch, such practice can be really fruitful only if the instruction in physics and mathematics be intrusted to one and the same teacher, as has been suggested by the brackets of the time-table. In the modern schools, owing to the greater number of hours there is not an equal measure of necessity for this combination.

To give an indication of the relations between teacher and pupil I quote once more from W. S. Learned's most interesting report (pp. 354–355, 365):[1]

> The fundamental conception of the teacher is that of one who inculcates a given body of knowledge in the mind of a preferably passive pupil. The ideal teacher is a master of his subject and an expert in its presentation; the ideal pupil is one who is completely receptive. The teacher imparts and drills; the pupil receives and repeats. With this in view nothing is omitted that will assist in focusing the attention directly on the teacher. "Textbooks" such as are used everywhere in America, with introduction, explanatory notes, tables, charts, diagrams, etc., do not exist. Textbooks in Germany are literally confined to the "text" or, in history, to the barest outline of the ground to be covered, while all supplementary material, such as biographical and explanatory notes, suggestions on hard places, the flesh and blood of historical narrative, etc., are provided by the teacher, who sets all forth in the best style at his command in the form of an uninterrupted lecture from which the pupils make what notes they wish. For all of this they are held directly responsible on the following day in an exhaustive oral examination which forms the counterpart to the lecture, the two exercises dividing the time about equally. * * * Voluntary questioning on the part of the pupil was in my experience wholly lacking. The whole spirit of the instruction is against it, and I think it would be regarded in most classes as irrelevant if not impertinent. * * * What we know as school loyalty simply doesn't exist. It is a matter of keen regret on the part of many a warm-hearted director and master, but the fact remains that the German student in both university and school regards his alma mater with the total indifference and apathy which he naturally feels toward, perhaps, the postal system put at his disposal. This is varied only by the sense of freedom and relief with which he leaves the institution which in his mind stands for strain, struggle, and restriction, without the counterbalancing notions of opportunity and sympathetic inspiration.

The most important examinations in connection with the secondary schools are the intermediate examination (Abschlussprüfung) at the end of the sixth school year, and the leaving examination (Abgangsprüfung, Abiturientenprüfung, Maturitätsprüfung, or Reifeprüfung)[1] at the end of the ninth year. This latter is the first real test of the pupil's ability, and we have already seen that those who meet its requirements have essentially advanced in their careers. All secondary schools approved by the minister of education have the right of holding this examination.

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[1] Some aspects of a Gymnasium pupil's activities 40 years ago were given by Hugo Münsterberg in "School Reform," *Atlantic Monthly*, May, 1900, vol. 85, p. 659f.

The examination committee consists of a commissioner, who is usually the inspector (Schulrat) of the school (appointed by the Provinzialschulkollegium), the director of the Gymnasium, Realgymnasium, or Oberrealschule, as the case may be, and the teachers of Oberprima.

The examinations are both written and oral, and the questions must be such as would be familiar to those in Prima. For the Oberrealschule the written examinations are in (1) a German essay; (2) a French or English essay; (3) a translation from German into French or English; (4) four problems in mathematics—one each from algebra, plane geometry, solid geometry, trigonometry, and analytic geometry; and (5) one problem in physics or chemistry. The subjects of oral examination are religion, French, English, history, mathematics, and either chemistry or physics.

In the written examinations the time allowed for the German essay is five hours, for mathematics five hours, for French or English three hours. The papers in each subject are read by the teachers concerned, and the grades "very good," "good," "satisfactory," "barely satisfactory," or "unsatisfactory," assigned according to the merits of the papers.

After all papers are examined and the errors noted, the committee discusses the attainments of each candidate and decides who should or should not, in its opinion, be admitted to the oral examination. A detailed report of the decisions in respect to the standing of all pupils is then made to the Schulkollegium. To it also are submitted copies of the examination papers and of the answers handed in by the students. These are finally examined by the Schulrat, who approves the decisions or makes such changes as he may deem wise. Some weeks later he sets a date for the oral examination.

At the oral examination pupils are brought in groups of 10 before a disconcerting array of 30 or 40 critical witnesses, many of them garbed in frock coats and white gloves. The Schulrat presides, and others present include a representative of the city authorities and the whole teaching staff of the institution. The teachers of the subjects of the examination take the lead in the quizzing, but at any point the Schulrat may also interject questions.

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[1] In this connection the following work is of interest: A. Schaeffer, *1400 mathematische Abiturienten-Aufgaben mit 700 Lösungen und Anleitungen zur Lösung als Uebungsbuch für Sekunda und Prima sowie zum Selbstunterricht.* Zabern, A. Fuchs, 1910. 16+240 pp.

A candidate fails to pass if he is "unsatisfactory" in German or in both modern languages. He may pass, however, even though "unsatisfactory" in one modern language, if he is at least "good" in the other or in German or in mathematics. If "unsatisfactory" in mathematics, he must be at least "good" in physics or chemistry. In case of failure the last year's or half year's work must be repeated.

The final grades are based not only upon the results of the written and oral examinations, but also upon an inspection of the complete records of the candidate's work during Prima. As compared with the French system two features are especially striking: (1) The large part which the teacher plays in the Abiturient examination; (2) the small percentage of failures—in 1902 only 15 per cent in the Abiturient examination as against 55 per cent in the bachelier examination in France. That the difference in the method of examinations contributes largely to the disparity in the percentage of candidates who pass is usually conceded. A closer study of the comparative questions involved would be of interest. Of course the young Abiturienten are on an average a year older than the bacheliers. Their scholastic training is therefore about equivalent to that of a student who has completed his junior year at one of the best American universities. The average age of such a student is about 22. The following table gives the percentage of Abiturienten of different ages in Prussia in 1907–8.

	Percentage of students aged—				
	17	18	19	20	21 and older.
Gymnasiasten	4.9	26.6	30.2	20.0	18.4
Realgymnasiasten	4.1	30.1	34.8	18.6	12.4
Oberrealschüler	3.6	26.4	34.4	23.9	11.8

Examples of mathematical questions set in Reifeprüfungen in Wurttemberg and Hamburg are given in Appendix E.

TRAINING OF SECONDARY-SCHOOL TEACHERS.

The regulations with regard to the scientific training of teachers for secondary schools in Prussia have been adopted by 11 other States,[1] and there is no great divergence in the methods of still other States. It should not be inferred, however, that the same method of preparation implies that equal standards are maintained. It is nevertheless true that a candidate who has satisfied the requirements of Leipzig, or Karlsruhe, or Giessen, or Rostock, or Jena, or

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[1] Alsace-Lorraine, Mecklenburg-Schwerin, Oldenburg, Brunswick, Mecklenburg-Strelitz, Anhalt, Saxe-Coburg-Gotha, Waldeck, Lubeck, Bremen, and Hamburg.

Brunswick, or of Strassburg has equal privileges in Prussia with the candidate who has passed the corresponding examinations there, just as the latter has equal privileges with the former in Saxony, or Baden, or Hesse, or Mecklenburg, or one of the Thuringian States [1] or Brunswick, or Alsace-Lorraine, or in States which have no examination commission.[2]

Because of its predominating influence, a description in some detail [3] is first given of the Prussian system of training secondary school teachers; then follow brief sketches of the corresponding organization and, when possible, mathematical examination questions for each of the seven other States with a population of not less than 1,000,000, namely: Bavaria, Saxony, Wurttemberg, Baden, Alsace-Lorraine, Hesse, and Hamburg.

1. PRUSSIA.

A candidate for appointment as teacher of mathematics in one of the higher schools must first of all have completed the full course of a Gymnasium or Realgymnasium or Oberrealschule. He must also have studied for not less than 6 semesters (the average is nearer 8 or 10) at one or more of the German universities,[4] directing his attention specially to those subjects in which he is later to be examined.

The examination is known as the examination pro facultate docendi or the Staatsexamen and is conducted by a royal examination commission (Königliche Wissenschaftliche Prüfungskommission) which is composed for the most part of university professors and schoolmen; the chairmanship is given to a schoolman. There are 10 of these examination boards in Prussia, one in each of the university centers mentioned above.[5]

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[1] The Thuringian States are: Schwarzburg-Rudolstadt, Schwarzburg-Sondershausen, Reuss Ä. L., Reuss j. L., Saxe Weimar, Saxe Meiningen, Saxe Coburg-Gotha and Saxe Altenburg.

[2] See W. Lorey, *Staatsprüfung und praktische Ausbildung der Mathematiker*, page 90.

[3] In this connection I have frequently drawn upon the official regulations of J. F. Brown's work.

[4] It is only in exceptional cases that a candidate may spend less than three semesters in a Prussian university. For candidates who expect to teach mathematics, physics, and chemistry, regular study in a German technical school (Technische Hochschule) is reckoned equal to study in a German university to the extent of three semesters. A candidate who seeks a teaching certificate in French or English and has devoted himself to linguistic studies along with scientific pursuits in countries where these languages are spoken may, by special permission, have this period of study count for as much as two semesters toward the prescribed period of university work.

[5] In 1910 the number of members in the examining boards varied from 28 at Konigsberg to 45 at Berlin. In all 10 commissions there were 350 members. Of these, 37 were examiners in mathematics, 21 in physics. In pure mathematics the examiners were as follows: *Konigsberg*—Meyer and Schoenflies; *Berlin*—Lampe, Knoblauch, and Färber; *Greifswald*—Engel and Vahlen; *Breslau*—Rosanes, Sturm, Kneser, and Vogt; *Halle a. S.*—Cantor, Wangerin, Gutzmer, and Eberhard; *Kiel*—Pochhammer, Heffter, and Landsberg; *Gottingen*—Klein, Hilbert, and Landau; *Munster*—Killing, v. Lillienthal, and Blankenburg; *Marburg*—Hensel and Neumann; *Bonn*—Study, London, and Hausdorff. All of these are professors in universities except Lampe, of the Technische Hochschule; Färber, professor in an Oberrealschule; and Vogt and Blankenburg, professors in Gymnasien.

A written application for examination must be sent by the candidate to the chairman of the commission in the district where the candidate has spent the last and at least one earlier semester of his university course. The application must specify (1) the subjects and the grades or classes [1] for which the candidate expects to qualify to teach; (2) the field in which the candidate wishes to receive subjects for the two home essays or theses, one in the "general examination" and one in the "special-subject examination."

The application must be accompanied by—

(*a*) A biographical sketch in the candidate's own handwriting, including a detailed account of his school training and academic studies.

(*b*) The originals of the certificates showing that the candidate has done the required work at higher school and university.

(*c*) A statement of military status.

(*d*) In case the candidate has already received the degree of doctor of philosophy, a copy of the doctor's dissertation and of the doctor's diploma.

The examination consists of two parts:[2] The general examination and the special-subject examination. Both of these are divided into written and oral parts.

The general examination is for the purpose of testing whether or not the candidate possesses the general culture demanded of all teachers in higher schools. The subjects for examination are philosophy, pedagogy, German literature, and, for the candidate who belongs to the Christian church, religion. The home thesis may be on any one of these subjects, and in it the candidate must not only manifest adequate information and intelligent judgment concerning the subject treated, but also show himself capable of a grammatically correct, logically arranged, clear, and sufficiently skillful presentation. For the oral examination it is required that the candidate (*a*) shall be acquainted with the most important facts in the history of philosophy and with the principles of logic and psychology, and shall have intelligently read an important philosophical treatise; (*b*) shall be familiar with pedagogy in respect to its philosophical foundations as well as with the most important phenomena in their development since the sixteenth century, and shall have already attained to some understanding of the problems of his future calling; (*c*) shall demonstrate that he is familiar with the general course of development of German literature from the beginning of the blooming period in the eighteenth century, and that since leaving school he has also read with understanding for his own further development the important works of the present day; (*d*) shall show himself acquainted with the content and connection of the Holy Scriptures, with a general survey of the history of the Christian church, and with the principal doctrines of his denomination. The general examination is a formidable ordeal, and as each examiner is usually a university professor and a specialist in the subject the candidate frequently anticipates this examination with greater apprehension than that in the special subjects which he is preparing to teach.

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[1] Certification in individual subjects is of two grades: (*a*) The second grade for lower and intermediate stages of secondary schools—that is, including Untersekunda; (*b*) the first grade for the upper stage—that is, including also the classes Obersekunda, Unterprima, and Oberprima.

[2] Exclusive of the stamp to be placed on the certificate, the fees amount to 60 marks ($14.28) for the entire examination.

The special-subject examination is to test the acquaintance of the candidate with the subjects which he expects to teach. The State regulations list 17 subjects,[1] in 3 of which,[2] a major and two minors, the candidate must qualify. Choice is limited in several respects. For example, when pure mathematics is a major, physics must be a minor; and applied mathematics as a major can be chosen only in connection with pure mathematics as a minor. Pure and applied mathematics and physics are frequently chosen together; chemistry with mineralogy, or botany and zoology, or geography are also elected with pure mathematics and physics, but such a third subject as French or English is also possible.

To pass the special-subject examination the candidate must qualify for the first grade in at least one of the subjects and in two more subjects for the second grade; he may be certified to instruct in the first grade, even though in his application he intended to qualify only for the second grade.

The official regulations make the following statements with regard to the requirements of the special-subject examination in pure mathematics, applied mathematics, and physics:

> Of candidates who wish to qualify to teach *pure mathematics* there is required: (*a*) For the second grade, a thorough knowledge of elementary mathematics, familiarity with plane analytic geometry, especially the principal properties of conics, as well as with the fundamental principles of differential and integral calculus; (*b*) For the first grade, in addition, an acquaintance with the principles of higher geometry, arithmetic, and algebra, of higher analysis and analytic mechanics sufficient to enable the candidate to work out a fairly difficult problem in this field without assistance.
>
> Of candidates who wish to qualify to teach *applied mathematics* there is required, in addition to qualification to teach pure mathematics: Knowledge of descriptive geometry, including the principles of central projection and corresponding facility in drawing; acquaintance with the mathematical methods of technical mechanics, especially of graphic statics with elementary geodesy and the elements of higher geodesy, in addition to the theory of adjustment of errors in observation.
>
> Of candidates who wish to qualify to teach *physics* there is required: (*a*) For the second grade, knowledge of the more important phenomena and laws of the whole field of

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[1] (1) Christian religion; (2) introduction to philosophy; (3) German; (4) Latin; (5) Greek; (6) Hebrew; (7) French; (8) English; (9) history; (10) geography; (11) pure mathematics; (12) applied mathematics; (13) physics; (14) chemistry with mineralogy; (15) botany with zoology; (16) Polish; (17) Danish.

[2] A candidate is not prohibited from choosing a larger number of subjects.

this science, as well as the ability to prove these laws mathematically as far as this is possible without the application of higher mathematics; acquaintance with the most important apparatus required for school instruction and practice in its use; (*b*) for the first grade, in addition, a more exact knowledge of experimental physics and its applications; familiarity with the fundamental investigations in one of the more important fields of theoretical physics, and a general survey of the whole field of science.

The second thesis is on a subject for which the candidate seeks a first grade. To finish this thesis as well as that of the general examination a limit of 16 weeks, beginning with the day of delivery of the themes, is granted. Under certain circumstances the examination commission may extend the time not to exceed 16 weeks more. For one of the two theses a dissertation regarded by a Prussian faculty of philosophy as satisfactory for the degree of doctor of philosophy may be accepted as equivalent. The examination commission may require a candidate to stand a written examination on any subject of the special-subject examination. The time allowed for this does not exceed three hours.

The oral examinations occur after the written examinations, and after the theses have been handed in. Upon special request of the candidate the chairman of the commission can separate the oral examinations of the general and special subject examinations by a period not to exceed three months.

After the oral examinations the commission determines whether or not according to the results of all tests the certificate is to be marked "satisfactory," "good," or "excellent." For the predicate "good" or "excellent" the candidate must have qualified for the first grade in at least two subjects. The certificate is now much less elaborate than formerly. The following is a sample of a certificate at Munster in 1906:

Herr ...., son of ...., born the .... of ...., 1882, at ...., and of .... confession, graduated Easter, 1902, at the Gymnasium in .... and studied mathematics and natural science from Easter, 1902, to Easter, 1903, at Munster, in the summer of 1903 at Gottingen, and from the spring of 1903 to the spring of 1905 at Munster.

On the basis of authorization, dated October 25, 1905, to be admitted to the examination for the position of teacher in the higher schools, he received the following themes for theses:

In mathematics: The geodetic representation of a surface on a plane. In philosophy: The different intrepretations of psychophysical law.

The oral examinations took place in the period from November 20 to December 4, 1906.

Herr .... took the examination for the position of teacher in the higher schools, and according to the entire result of written and oral examination, the certificate is marked "Good"; he is qualified to teach mathematics as well as botany and zoology in the first grade; physics in the second grade.

For information concerning the work of the Seminarjahr, you are referred to the ordinance, dated March 15, 1890, for the practical education of candidates for the position as teacher in higher schools.

ROYAL SCIENTIFIC EXAMINATION COMMISSION.

Munster, December 4, 1906.

(Signed) CAUER. SPICKER.
KILLING. KONEN.
BUSSE. ZOPF.
FELL. BELLOWITZ.
GEYSER. BUSZ.

Under certain conditions examinations covering deficiencies in the first examination are allowed. The percentages of failures in the Staats-Examen in all subjects (there are no special statistics for mathematics) are considerable. For the year 1908, these varied from 20 per cent at Gottingen to 47 per cent at Munster. To most of the mathematical candidates who passed the predicate "Satisfactory" was assigned. The following exact statistics may be of interest:

Results of the Staats-Examen.

Universities.	Satisfactory.	Good.	Excellent.
Berlin	28	6	5
Bonn	17	8	0
Breslau	3	2	0
Gottingen	18	14	2
Greifswald	9	0	0
Halle	16	5	1
Kiel	4	2	0
Konigsberg	7	4	2
Marburg	23	0	0
Munster	13	6	0
Total	138	47	10
Per cent	70.7	24.1	5.2

Of all dissertations presented in 1908, 34.9 per cent were not accepted. Less than one-half of the Prussian teachers have taken the trouble to secure the doctor's degree, which they look upon as a somewhat unnecessary luxury. For many years no written examination was required of candidates with a university degree.

Anyone who has the above-mentioned certificate can, within the six following years, take an additional examination, either to qualify for instruction in new subjects or to extend the certification already granted, in order to raise the final standard of the certificate, provided he is recommended for admission to such examination by the Provinzialschulkollegium under which he has been working or is appointed to work.

The examination pro facultate docendi was first established in 1810, and by 1826 Prussia had introduced a plan requiring all candidates who had completed this examination to spend a probationary year (Probejahr) as trial teacher (candidatus probandus) in some approved school. In time it became apparent that the Probejahr did not adequately meet desired requirements, that something should be done to shut out undesirable candidates and to elevate the standard of professional attainments. These considerations and pedagogical experiments made by Ziller at Leipzig, Stoy at Jena, and especially by Frick at Halle, led to a decree in 1890, establishing a Seminarjahr in which the candidates are to be "made familiar with the theory of education and instruction in its application to the secondary schools and with the methods of the individual subjects of instruction; they are also to be introduced to the practical work of the teacher and educator." The Probejahr now serves primarily as a test of the teaching skill won during the Seminarjahr. The following descriptions of the two years of practical training of candidates in Seminarjahr and Probejahr are based upon the revised regulations of 1908:

Seminarjahr.—Application is made to the Provinzialschulkollegium in whose district the candidate wishes to pass the Seminarjahr. The application must be accompanied by: (*a*) The certificate of having passed the Staatsexamen; (*b*) a certificate from an official physician attesting that the candidate has the necessary health and the physical qualifications for the profession of a teacher; (*c*) a statement setting forth the ability of the candidate to support himself during the period of practical training; (*d*) a statement of military status.

Seminarien are organized in connection with various higher schools, and the Provinzialschulkollegium assigns the candidates to schools at Easter and in the autumn. Not more than six candidates may be assigned in a given year to any one seminar and in their distribution the teaching subjects of the candidates, as well as the specialties of the different Seminarien, are taken into consideration.

The director and the teachers of a Seminar are named by the Provinzialschulkollegium from among the staff of the higher school where the Seminar is located. The systematic training and practice of the candidates is carried out in accord with the following regulations:

For the instruction of the candidates weekly sessions of at least two hours each are to be held during the whole year (vacation time excepted) under leadership of the director or one of the teachers named; to these sessions the other teachers are to be admitted also. In these meetings the academic form of lectures is to be omitted as far as possible; on the other hand, emphasis should be laid on discussion and instruction concerning the requirements of practical school life. The following subjects in particular must be treated:

Principles of training and instruction, together with their applications to the general problems of the secondary schools, and with special reference to the conduct of the subject in which the candidate is preparing to teach.

Historical survey of the evolution of secondary schools, including an account of the leaders in pedagogy and also including comments on the most important present-day situations in the educational world.

The constitution and organization of secondary schools, the official course of study and regulations regarding examinations, the rules regarding student credentials and promotion.

Principles of school discipline illustrated so far as possible by current examples, and by discussions of examples of a concrete type which have come up in the school at other times, rules of conduct for students, discussions of the relation between school and home.

School hygiene with special reference to equipment of the classroom and to the conduct of the class work.

Supervisory authorities, rules, and regulations governing the official relations of the teacher and class masters (Ordinarien [1]), including the forms of official communications and reports.

Provision is also made for (1) visits to classes by the candidate; (2) supervision of the preparations for instruction made in the subject which the candidate is himself to teach, and of the methods of correcting and handing back the work of pupils; and (3) discussion of the personal or other aspects of the trial teaching of candidates.

In the same section of the regulations we find that—

according to the requirements of the chairman, the candidate must deliver short reports on subjects lying within his field; he must also give lectures in which special emphasis should be laid on the training of the candidate in fluent speaking.

Minutes of each Seminar meeting must be prepared by one of the candidates. These are kept as formal record of the work done at the conference. Parts of these minutes, as well as of the topics given to the candidates for their reports and their theses, to be referred to presently, are exchanged between Seminarien for the mutual stimulation of teachers and directors.

Practice teaching begins as soon as the candidate feels somewhat at home in the institution. The regulations state:

In these lessons the teaching topics, which at first are limited in time and importance have to be gradually extended according to the ability of the candidates, so that they may have the opportunity to test their own power and to be trained in independent instruction. For these lessons the candidates must outline the subject matter, and, as long as the supervising teacher thinks it necessary, they must perpare a lesson plan.

* * *

About once a month the candidates must teach lessons at which, as a rule, in addition to the director, the regular teacher of that subject and the other candidates must be present. These lessons are to be discussed in the general meetings with reference to their plan and development (as noted above); in this discussion attention must be drawn to mistakes which the candidates have made in their preparation, in the pedagogical treatment of the pupils, and in their own attitude before the class. * * *

The candidates must also take part in the direction of play hours, and, when necessary, also of work hours, as well as in the physical exercises of the pupils and in school excursions.

As far as the local school conditions permit, candidates should sometimes be given opportunity to attend lessons in the Seminarien of elementary teachers and in different kinds of elementary schools. * * *

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[1] Each of the nine classes of a higher school has a class master or Ordinarius, who is a regular teacher chosen by the director to act as his representative. "The class master is expected to be a teacher, guide, and friend of his class. All other teachers report to him, and the class record is his special care. Pupils must first seek his advice before going to the director; he becomes personally acquainted with the parents of his boys; he studies the condition of their home life and their conduct out of school; he has charge of the trial teachers who may be assigned to the class, and sees to it that no harm comes from their teaching; and in all faculty conferences he acts as spokesman for his class. From the reports of other teachers he knows just what each boy is doing, and is prepared to talk intelligently with teacher or boy, as the case may be. Thus, he is responsible for the industry, progress, and morals of his charges."

About two months before the end of the Seminarjahr every candidate must hand in a thesis on a topic assigned to him by the director. These theses, in the choice oftopics for which the reasonable wishes of the candidates should be considered, are, as a rule, so constructed that they include theoretical considerations and practical applications. They should not involve the treatment of an elaborate literary subject, but they should give the candidate the opportunity to work out a literary subject within his field and to connect it with his own observations and experiences. Even if the candidate has had a very extensive teaching experience, exemption from this final thesis is not granted.

The titles of some recent theses at the Seminar connected with the Realgymnasium at Remscheid are as follows:

On instruction in plane geometry for beginners.

Introduction to algebra based upon simple equations in Untertia.

The discussion of trigonometry in Untersekunda.

Differential and integral calculus in the mathematical instruction of the Realschulen.

At the Seminar connected with the Klinger-Oberrealschule in Frankfort on the Main the themes assigned included the following:

1901. Three lessons in Unterprima of the Oberrealschule forming an introduction to synthetic geometry of conics.

1902. The area of the circle. Three lessons in Obertertia.

1903. The reflection of light, discussed in four lessons in Untersekunda of an Oberrealschule.

1905. The circle and proportion. Four lessons in Obertertia—pole and polar with respect to a circle and other conics. Four lessons in Unterprima of an Oberrealschule.

1907. The triangle in geometry for beginners (Quinta). The complete quadrilateral and quadrangle in Unterprima. The principle of duality, three lessons. Three lessons on maxima and minima.

1910. Discussion of the *regula falsi* and Newton's method for approximate solutions of an equation. Three lessons.

At least three weeks before the end of the Seminarjahr the director must present to the Provinzialschulkollegium a detailed characterization of each candidate on the basis of personal observation made during his training. This characterization treats of—

the conduct and activity of the candidate during the Seminarjahr, of his ambition, his capacity for scientific work, his ability to teach and the stage reached in his practical training; it further covers his state of health, his financial position, his social attitude, and his behavior toward his colleagues, so that the supervising authorities may be acquainted with special talents as well as with striking shortcomings in the candidate's conduct, ambitions, and attainments. The thesis with the criticism of the director or the teacher in charge [1] and the application for admission to the Probejahr, must accompany the characterization.

If it is the unanimous opinion of the Provinzialschulkollegium that the candidate appears unfit for the teaching profession, the candidate is informed that he can not be admitted to the Probejahr.

In 1909 there were 125 Seminarien throughout Germany. Of these the 49 in Prussia with a capacity of approximately 300 candidates were of two types: (1) The 12 State institutions under the direction of the Provinzialschulkollegien; (2) the much more numerous class of institutions connected with leading Gymnasien, Realgymnasien, and Oberrealschulen, and each under the control of the director and some associates in the school.[1]

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[1] The predicates "satisfactory," "good," and "excellent" are employed in this connection.

There are many who consider that the Seminar system of Saxe-Weimar is founded on sounder basis than is that of Prussia. In this Duchy the candidate is required to attend lectures on general pedagogy at the University of Jena, to teach at least two hours per week in the university practice school, and to carry on the work of the Seminarjahr and Probejahr in the city Gymnasium where the higher-school practice teaching is done.[2] In this way prospective secondary-school teachers can avail themselves of more scientific and critical treatment of training than is possible on the part of a busy director and his staff.

In the summer semester of 1909 and the winter semester of 1909–10 the following courses were given at the University of Jena: Elements of empirical psychology (2 hours a week during a semester); applied psychology (2 hours); attention (1 hour); general didactics (2 hours); pedagogic seminary (3 hours a week during a year); psychology (2 hours a week during a semester); neurological diagnosis with practical exercises (1 hour); discovery and treatment of mental weakness in youth, for physicians and teachers; principal problems of ethics and jurisprudence (2 hours); Herbart (2 hours); special didactics (3 hours).

There are other university Seminarien at Leipzig and Giessen, but while most of the universities give courses which are especially valuable for the professional training of teachers, some universities are hostile to closer relations. The Universities of Munich and Wurzburg are of the opinion that "pedagogy as an isolated science is able to produce no creative, scientific work;" that "the university has for its purpose the advancement of the scientific and purely cultural training of students;" that "the union of practice schools with the universities should be opposed not only by considerations of principle, but by great practical difficulties as regards the personnel of teachers, the number of pupils, and local relations."

The following courses were offered at the University of Berlin[3] in the summer semester of 1909:

> General psychology (2 semester hours); theoretical and experimental exercises in psychological institute (3 hours); the soul of primeval races (3 hours); exercises in race psychology (1½ hours); pedagogic theories from Plato to Rousseau (2 hours);

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[1] The best book on the subject of the gymnasial Seminar seems to be *Das padogogische Seminar*, by Dr. Karl Neff, of Munich (Beck, 1906). It is the result of 11 years' experience since Bavaria adopted the Prussian system in 1897.

[2] In his work on *Training of Teacher*, J. F. Brown gives (pp. 92–107), "Regulations for the pedagogical seminar of the university and its practice school at Jena."

[3] Cf. Rep. U. S. Commiss. of Educ., 1912–13, vol. 1, Washington, 1914, pp. 823–24.

scientific pedagogic exercises (1 hour). In the winter semester: Psychology with demonstrations (4 hours); lectures, and experimental and theoretical exercises, in psychological institute (10 hours); general psychology (2 hours); the psychological foundations of education (1 hour); ethics (2 hours); Kant's ethics (1 hour); problems of modern culture (2 hours); the theory of instruction (2 hours); scientific pedagogic exercises (2 hours); discussion of experimental pedagogy in connection with lectures (1 hour).

Probejahr.—The Probejahr gives opportunity for consecutive teaching under continual inspection and criticism in an institution which is usually different from that in which the Seminarjahr is spent. The candidate is intrusted, according to his qualifications, with larger connected teaching problems and 8 to 10 hours a week of actual class work. The candidate is also obliged to exercise supervision, to attend teachers' conferences, to assist the director in making out reports and checking lists, and otherwise to identify himself with the life of the school. For this heavy burden of work no compensation is given. In exceptional cases the Provinzialschulkollegium may employ the probandus as a scientific assistant, for substitute teaching or for additional work.[1] In this case the candidate receives remuneration; he also receives the right to vote in teachers' conferences on all questions which concern the classes he conducts.

The director must watch the conduct and activity of the candidate, visit him from time to time in his lessons, and draw his attention to accidental mistakes and, if necessary, warn him seriously by indicating the consequences of disregarding this advice.

The teacher in charge of the training of the candidate is obliged to attend the candidate's lesson very often in the beginning, later at least twice a month; to examine the papers which he has corrected; and to advise him concerning matters outside of instruction.

The candidate should learn to use critically Reidt's *Anleitung zum mathematischen Unterricht*, Simon's *Didaktik*, and Höfler's recent *Handbuch des mathematischen Unterrichts;* similarly with the handbooks and encyclopedias of Killing-Hovestadt, Thieme-Färber, Schwering, and Weber-Wellstein.[2] The candidate should also work through F. Klein's *Vorlesungen über Elementarmathematik vom höheren Standpunkte aus.*[3] The study of the history of mathematics is also specially recommended to the candidate if he has already carried on some historical study in mathematics.

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[1] In such cases the amount of class teaching may be as much as 20 to 24 hours a week.

[2] W. Killing und H. Hovestadt, *Handbuch des mathematischen Unterrichts*. Leipzig, Teubner, 1910–1913. 2 vols., 456+482 pp.

H. Thieme und C. Färber, *Grundlehren der Mathematik*. Leipzig, Teubner, 1909–1912. 4 vols.

K. Schwering, *Handbuch der Elementar mathematik für Lehrer*. Leipzig, Teubner, 1907. 416 pp.

H. Weber und J. Wellstein, *Enzyklopädie der Elemetar-Mathematik*. Leipzig, Teubner, 1909–1912. 4 vols.; 550+608+548+681 pp.

[3] A sketch of the teaching, in German universities, of elementary mathematics from higher standpoints, is given in Lorey's *Das Studium der Mathematik an den deutschen Universitäten*, pp. 263–271.

As evidence of the amount of pedagogical insight obtained, the candidate must present to the director toward the end of the Probejahr a report concerning his own work as teacher.

At least three weeks before the close of the year the director reports concerning the candidate to the Provinzialschulkollegium. The nature of the report is similar to that described above in connection with the duties of the director of a Seminar. On the basis of these reports, of the observations of the district advisers (Schulräte) and of the result of the two years of practical training, the Kollegium soon decides whether or not the candidate possesses *Anstellungsfähigkeit* or qualification to have his name inscribed on the list of teachers eligible to appointment in the higher schools.

If there is doubt as to the candidate's qualifications, the Probejahr is prolonged six months. In any case a certificate concerning the teaching ability of a candidate can never be granted if—

> in the meantime it has been proved that the candidate either through physical defects or through unavoidable pedagogic defects is unable to fulfill his duties as a teacher or educator of youth, or if the candidate on account of his conduct within or without the school appears unfit for the teaching profession.

It rarely happens that a candidate fails of certification at the end of the Probejahr, since his defects are almost sure to be brought to light in the Seminarjahr which is extended for a year or half year at another seminar when any doubt exists as to his qualifications for the Probejahr.

Teachers in all secondary schools, whether under State, city, or other patronage must be selected from the provincial list. But while State institutions are required to select their teachers with the desired qualifications in order of seniority on the list, other schools are free to select, regardless of order, from the six highest on the list. In recent years the appointment of teachers to positions has followed very soon after their names have been placed on the official list. For interesting details regarding appointment and promotion of teachers, the reader may consult J. E. Russell's work (pp. 370–381), written about 18 years ago.[1]

To make more apparent the opportunities of the future teacher for studying mathematics at the university it may be well to consider details concerning specific cases. As even in Germany the very large number of courses in pure and applied mathematics which are offered each year at the University of Gottingen are quite exceptional,[2] the following illustrations are cited: (*a*) The courses offered at the University of Berlin during the summer semester of 1914; (*b*) the actual list of courses of study (with the exception of those in botany, zoology, and philosophy) which an Oberlehrer took at the University of Bonn in preparation for his present position.[1] He spent the fourth semester of university study at Berlin, where he heard lectures on the theory of numbers by Frobenius and on algebraic equations by J. Schur.

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[1] An interesting discussion of the preparation of teachers in Prussia is contained in W. Killing's "Bemerkungen über die Ausbildung der Gymnasiallehrer," *Jahresbericht der deutschen Mathematiker-Vereinigung*, Band 22, 1913, pp. 20–34.

[2] For an account of mathematics at Gottingen, see Lorey's *Das Studium der Mathematik an den deutschen Universitäten*, pp. 347–359.

(*a*) Derivation of the most important properties of conic sections by means of elementary geometry (2 hours a week) by Schwarz; analytic geometry (4 hours), Schottky; differential calculus (4 hours), Knopp; integral calculus (4 hours), Knoblauch; theory of determinants (4 hours), Frobenius; theory of infinite series, infinite products, and continued fractions (4 hours), Knopp; introduction to the theory of ordinary differential equations (2 hours), Hettner; space curves and curved surfaces (4 hours), Schwarz; analytic mechanics (4 hours), Lehmann-Filhés; applications of elliptic functions (4 hours), Knoblauch; calculus of variations (4 hours), Schwarz; theory of theta functions (4 hours), Schottky; exercises in differential calculus (2 hours fortnightly), Knopp; exercises in differential and integral calculus (1 hour), Knoblauch; exercises in mechanics (1 hour), Lehmann-Filhés; mathematical colloquium for advanced students (2 hours fortnightly), Schwarz; mathematical seminary (2 hours), Schwarz, Frobenius, Schottky (each professor directed the seminary once in three weeks).

(*b*) *1. Semester* (1906): Differential calculus with exercises, Kowalewski; descriptive geometry with exercises in drawing, London; experimental physics (electricity and optics), Kayser. *2. Semester* (1906–7): Laboratory physics for beginners, Kayser; experimental physics (mechanics, heat, acoustics), Kayser; integral calculus with exercises, Kowalewski; elements of analytic geometry with exercises, London; introduction to algebra, Schmidt; theory of determinants, Schmidt. *3. Semester* (1907): Laboratory physics for beginners, Kayser; experimental physics (repeated), Kayser; physical units and constants, Kaufmann. *5. Semester* (1908): Selected chapters in analytic geometry, London; foundations and history of higher analysis, Kowalewski; readings and reviews of selected writings of Leibnitz and Newton, Kowalewski; mathematical seminary. *6. Semester* (1908–9): Fourier series and applications, Kowalewski; foundations of the theory of aggregates, Kowalewski; theory of electricity with exercises, Pflüger; mathematical seminary. *7. Semester* (1909): Differential geometry, study; differential equations, Kowalewski; theory of light, with exercises, Pflüger; elements of the theory of elections, Bucherer; mathematical seminary. *8. Semester* (1909–10): Synthetic geometry with exercises, London; introduction to theory of functions, Kowalewski; mechanics, Pflüger; physics colloquium, Kayser; applied theory of physics, Eversheim; mathematical seminary. *9. Semester* (1910): Analytic geometry, second part (repetition), London; foundations of geometry, Hessenberg; mathematical seminary.

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[1] W. Lorey, *Das Studium*, etc., pp. 342–43.

In the tenth semester this candidate passed the Oberlehrerprüfung and was certified as having scientific knowledge requisite for teaching mathematics, physics, botany, and zoology in the first grade. The combination of botany and zoology with mathematics and physics appears to be very common at Bonn as well as at other universities.

2. BAVARIA.

The method of training teachers for higher schools in Bavaria differs considerably from that in Prussia. In what follows there is given a description of (I) the training based upon regulations in force from 1895 to 1912; (II) the training required by decree of September 4, 1912.

I. The training consists of (*a*) an examination (Lehramtsprüfung) and (*b*) a so-called Seminarjahr. The Lehramtsprüfung is divided into two sections, the first at the end of four semesters of study in a university or technical school, and the second after eight semesters at a university or technical school.

In the first section of the examination the candidate is liable for examination in the following subjects: (1) Algebraic analysis and algebra, including equations of the third and fourth degree; (2) plane and solid geometry; (3) plane and spherical trigonometry; (4) elements of differential and integral calculus; (5) analytic and synthetic geometry of conics; (6) elements of descriptive geometry. About four hours are allowed for the examination in each of these subjects. Then five hours are set aside for (7) a German essay on a theme the treatment of which displays the general culture of the candidate. For each candidate the oral examination, lasting an hour, covers the subjects of the written examination and the foundations of physics. The following questions were set in 1908:[1]

Algebraic analysis (2 hours).—Prove that the series

$$1+\frac{\cos\phi}{1!}+\frac{\cos 2\phi}{2!}+\frac{\cos 3\phi}{3!}+\cdots\cdots\cdots$$

converges for all values of ϕ; calculate the sum of this series and express the sum in real form.

Algebra (1¾ hours).—For what values of λ does the equation $x^3-5x^2+2x=\lambda$ have the property that the difference of two roots is equal to 3? Determine the corresponding system of solutions of the equation and express the linear relation between λ and x.

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[1] The current questions are to be found in *Bay. Zeitschr. f. Realschulwesen* or *Blätter f. d. Gymnasialschulwesen*. Questions set for many years have been collected in *Prüfungsaufgaben f. d. Lehramt der Math. und Phys. a. d. Kgl. bayr. hum. u. techn. Unterrichtsanstalten* (*1873–1893*). Ansbach, C. Brügel u. Sohn, 1894.

Plane geometry (2 hours).—Any three points A′, B′, C′, are taken on the sides BC, CA, AB, respectively, of a triangle ABC. Prove that—

(1) the circles circumscribed about the triangles A′B′C, B′C′A, C′A′B meet in a point;

(2) the centers of these circumscribed circles are the vertices of a triangle similar to the triangle ABC.

Solid geometry (1¾ hours).—On an equilateral triangle the radius of whose circumscribed circle, *r*, is given, a right pyramid of height *h* is constructed. From the middle point of the circumscribed circle of the base perpendiculars are dropped on the faces of the pyramid and through each pair of perpendiculars planes are drawn. Find the common area and volume of any one of the resulting pyramids and the original pyramid.

Plane trigonometry (2 hours).—In a triangle ABC there is given $AB=c=80$, the length of the line segment $CC'=t=50$ (where C′ is the middle of the side AB), and the difference of the angles A and B or $\alpha-\beta=\delta=9° 49'.8$. Find the other two sides (first in general terms and then numerically).

Spherical trigonometry (2 hours).—At a place whose latitude is $\phi=48° 8'$, and at 3 o'clock in the afternoon on the longest day (declination of the sun $\delta=\epsilon=23° 27'$) it is desired to find the approximate cardinal points of the compass from the position of the sun, and accordingly it is supposed that the sun is in the southwest. How great is the error of this orientation?

At what hour of the day would this orientation error, due to interchange of azimuth and hour angle, be a maximum on that day and at that place?

Differential calculus (1¾ hours).—If $u=f(v)$ and $v=\varphi(x,y,z)$, find the derivative

$$\frac{\partial^3 u}{\partial x^3},\ \frac{\partial^3 u}{\partial x^2 \partial y},\ \frac{\partial^3 u}{\partial x \partial y \partial z}.$$

and express them as derivatives of f and φ.

Integral calculus (2 hours),—Prove by partial differentiation that

$$\int_0^\infty \frac{\sin x}{x}\,dx=\int_0^\infty\left(\frac{\sin x}{x}\right)^2 dx=4/3\int_0^\infty\left(\frac{\sin x}{x}\right)^3 dx=3/2\int_0^\infty\left(\frac{\sin x}{x}\right)^4 dx.$$

Analytic geometry of conics (2 hours).—A fixed tangent *a* of a parabola meets the tangent at a variable point P in T. The line segment PT is divided at Q so that $\frac{PQ}{QT}=\lambda$. Show that—

(1) the locus of Q is a parabola tangent to the given parabola at the point A where *a* is tangent to the curve;

(2) the loci of Q corresponding to different positions of *a* are congruent.

Synthetic geometry of conics (1¾ hours).—In a plane two lines g_1, g_2 and two points P and Q are given. Determine that line through P such that the part cut off by g_1 and g_2 is seen from Q under a right angle.

Elements of descriptive geometry (4 hours).—A plane (s_1, t_2) is given by its traces, also a point A by its projections A_1, A_2. A circle through A which touches the first trace s_1 and has at A a tangent parallel to s_1 is projected orthogonally on the plane (s_1, t_2). Draw—

(a) the projection plan;

(b) the true form of this projection;

(c) the cylinder employed in the projection; and

(d) its development (Abwicklung) so far as it is bounded by the plane (s_1, t_2) and the circle-plane.

The conditions to be satisfied before admission of a candidate to the second section of the Lehramtsprüfung are: (*a*) He shall have studied at a university or technical school for at least four years, of which seven semesters have been devoted to the study of mathematics and physics; (*b*) he shall have taken courses in laboratory physics and theory or history of pedagogy, and two courses in the second section of the philosophical faculty, especially one in inorganic chemistry; (*c*) he shall have completed a scientific thesis in the field of pure or applied mathematics or physics.

The titles of some theses in recent years are as follows:

On the radii of curvature[1] of the C_3, their envelope and pedal curve with respect to the center.

Envelope of the planes which cut off from a trirectangular trihedral angle a tetrahedron of constant area.

To exhibit three coplomar concurrent rays as the central projection of three rays concurrent in space.

Discussion of Rosenhain's threefold periodic functions with the aid of Weierstrass's "p" and "σ" functions.

Glissettes of points of curves tangent to a given line in a fixed point.

On space W-curves and W-surfaces.

On the geometric foundations of function theory based upon hyperbolic measurement.

On Laguerre's contact transformations.

Groups of substitutions which may be analytically exhibited as functions of the form az^m.

The employment of elliptic functions for the theory of the point systems of a general curve of the third degree.

Presentation of the methods of solution of the equation of the fifth degree in their historical development.

The oral examination consists of questions on the thesis, and on analysis, geometry, analytic mechanics, and physics. In particular such subjects as foundations of geometry, theory of functions, differential equations, differential geometry of plane and space may be discussed. In conducting the examination the special line of study of the candidate is taken into account. Furthermore, emphasis is laid on maturity in connection with subjects of the first examination. In mathematics, especially careful consideration is bestowed on those topics whose mastery tends to a truer understanding of subjects taught in secondary schools. In physics the candidate's facility in experimentation is tested. Theory and history of pedagogy are also subjects for examination. The whole examination lasts two hours.

Both parts of the Lehramtsprüfung are held in Munich before an examination commission of the royal State ministry.

The examination regulations contain yet another requirement. The candidate has to give a trial lesson (Lehrprobe) on an assigned theme in one of the middle schools of Munich before the assembled examination board. This test of teaching ability, for which a special predicate is assigned, is very peculiar in that the candidate is tested in something concerning which he has never been taught. At best it can only tend to indicate his natural ability. On the other hand a naturally good instructor may be confused by the large audience and the fact that he is not acquainted with any of his pupils. Nevertheless, every candidate who satisfactorily passes the Lehramtsprüfung and the Lehrprobe test is declared competent to teach all subjects in secondary school mathematics.

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[1] I have so translated *Krümmungssehnen* (p. 73 of Wieleitner's report on Bavaria).

Following the example set by Prussia, certain Seminarien for the training of teachers in ancient classics were established in 1893. It was not, however, till the spring of 1904 that two mathematical Seminarien came into being at the Theresiengymnasium and at the Realgymnasium in Munich. By 1906 two others had been established: One at the Realgymnasium in Augsburg and the other at the Realgymnasium in Wurzburg, but up to June, 1912, these four institutions were the only establishments of their kind in Bavaria. Since none of these Seminarien could train more than 6 or 8 candidates annually, while 40 to 50 were coming from the universities, training in a Seminar was not required for the candidate in mathematics. With the new regulations of 1912 the Seminarjahr became compulsory.

In the mathematical Seminar there are two special teachers (Seminarlehrer, one mainly in mathematics, the other in physics) in addition to two members of the regular staff who are Seminarleiter, or teachers who conduct the training. Of the four teachers only two are specialists in mathematics and physics.

Candidates enter the Seminar at the end of November; in the first weeks they observe the instruction of their Seminarlehrer and of the other teachers in the institution and after that give trial lessons (Probelektionen) at first for half an hour and later for the full hour. On these occasions the other candidates and the Seminarlehrer are always present. At the special Seminar meetings, which usually take place twice a week, the candidates must report concerning all classes which they have attended either as instructor or observer. At these meetings the "Praktikanten" hear discussions of a pedagogic-didactic nature and give lectures on general pedagogic questions or on methods of treating certain parts of mathematics and physics. The trial lessons of the Praktikanten are here criticised and every lecture is followed by general discussion. At the meetings the Seminarleiter and Seminarlehrer also give lectures on general questions, on duties as a teacher and to society, and on special topics of didactics and method. The number of lectures which each candidate gives varies from two to six. Themes employed for such lectures are as follows: Herbart's views on mathematical instruction; Klein's endeavors for reform; quadrature of the circle in instruction; mathematical instruction in France; hygiene in the schoolroom; the handling of lying in the school; the best texts in different subjects; how is rest in connection with instruction best taken? the slide rule; suicide of pupils;[1] review of new books; methods of construction according to Adler, Petersen, and Alexandroff; and similar themes in physics.

Minutes of all Seminar meetings must be kept by the candidates in turn. In this way each one has to prepare eight to ten sets of minutes. Before May 1 each one must also hand in a larger pedagogic thesis of which the theme was assigned the preceding January in consultation with the Seminarleiter and Seminarlehrer. The theses are discussed in Seminar meetings and written judgments are passed upon them. A selection of subjects (in so far as they are not in pure physics) assigned at the four Seminarien is as follows:

Of what significance for instruction in mathematics and physics are the six "interests" of Herbart? Appreciation of the attack of Ellen Key, Forel, and other moderns leveled against the traditional methods of instruction. Comparison of the light and dark sides of the system of specialist teachers and of class teachers. Self-criticism as one of the most necessary conditions of progress in successful instruction. Relation between pupil and teacher both within and without the school. The question of overworking and the humanistic Gymnasium of the day. What place should art occupy in a scheme of instruction? Comparative consideration of programs in mathematics and physics at various German institutions. Mental arithmetic. Teaching of fractions by question and answer. Graphic methods in the instruction of arithmetic and algebra as well as of trigonometry. How is the idea of a function to be developed according to the program of the Bavarian Oberrealschule? In the interests of concentration in mathematical instruction in the upper classes, how can the study of physics or natural science be promoted? (To be discussed on the basis of the program of Bavarian secondary schools.) How can the interest of a pupil be aroused to recognize mathematical manifestations in daily life? The German Museum[2] and the humanistic Gymnasium. Introduction to the similarity of figures. Theory of equality of areas and transformation of areas. Weights and measures in arithmetic instruction.

At the close of the Seminar course the authorities notify the ministry of approved candidates who in due course receive Befähigungszeugnisse as teachers. There is no Probejahr as in Prussia; and it is also to be observed that the Seminarien of Bavaria, organized for the most part to train in a special subject, are, in this respect, different from those in Prussia.

At the University of Munich in the summer semester of 1909 the following courses were offered: Psychology, with special reference to pedagogic questions involved (4 hours a week); psychology (4 hours); psychological exercises (2½ hours); art and race psychology (2 hours); anthropological psychology (4 hours); introduction to ethical problems (2 hours); introduction to problems of sociology (3 hours); history of pedagogic theories (4 hours). In the winter semester, 1909-10: General psychology (5 hours); psychology seminary (1½ hours); psychological exercises (1½ hours); psychology of Aristotle (1 hour); fundamental problems of ethics (4 hours).

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[1] This is a serious matter in Germany. That it is largely due to overwork seems to be established by the appalling condition of recruits for the army and navy from secondary schools of Prussia. More than one-third of the students are found physically unfit (see Rep. U. S. Commis. of Educ., 1909-10, vol. 1, Washington, 1910, pp. 482-3).

[2] Presumably the deutsches Museum von Meisterwerken der Naturwissenschaft und Technik, in Munich, of which the corner stone was laid in 1906.

In Bavaria, university "vacation courses" for those who are teaching in secondary schools are often largely attended. Such lectures were given for example at: (*a*) Wurzburg, April 21-27, 1908—Dr. Rost, 6 lectures on the productiveness of the employment of graphical aid in carrying out geometrical constructions, and Prof. Prym, 6 lectures on the derivation of fundamental functions in passing from lower to higher analysis; (*b*) Erlangen, April 13-19, 1909—Prof. Gordan gave 2 lectures on corresponding conics, Prof. Noether 2 lectures on the variation principle in mechanics, and Dr. Hilb 2 lectures on relations between higher and elementary mathematics.

Courses in the history of mathematics are not often given in Germany, but at the University of Munich Dingler is a privatdocent for the didactics, philosophy and history of mathematical sciences. His appointment in 1912 was the first of the kind.

II. Regulations of 1912. The candidate is still required to pass two examinations, namely, the two sections of the Lehramtsprüfung, but the first section does not come till after at least four years of study in a university or technical high school and the second section after the completion of a Seminarjahr. There is also a voluntary special examination.

The candidate's choice of subjects is more circumscribed in Bavaria than in Prussia. He is required to make selection from one of the following groups:

1. Classical languages, German language, and history.
2. German language, history, French or English language.
3. Modern languages.
4. Mathematics and physics.
5. Chemistry, biology, and geography.
6. Commercial science and geography.
7. Drawing.

Mathematics and physics must be chosen together, and no other subject may be elected with them.

For admission to the first division of the Lehramtsprüfung in mathmetics and physics the following are required:

(*a*) The Reifezeugnis of a Gymnasium, Realgymnasium, or Oberrealschule.

(*b*) The proof of study at a German university or technical high school for at least four years, at least three of which have been devoted to attending lectures on mathematics and physics, to laboratory practice, and to drill in exercises.

(*c*) A certificate of successful completion of courses of exercises in mathematics and physics.

(*d*) Proof of attending two courses of philosophic, historic, or geographic content.

(*e*) The presentation of two "Zulassungsarbeiten," which must be authenticated by directors of exercise drill or laboratory practice; one "Arbeit" of moderate scope, on some topic in mathematics or theoretical physics, should have been prepared in seminary or similar exercises, the other Arbeit should be in the nature of a report of work done in laboratory physics. The Zulassungsarbeiten must each display familiarity with the scientific subject and its literature, a methodical development, and well-ordered presentation.

In these conditions it is notable that practical exercises in both mathematics and physics are required and that certificates of the successful pursuit of these exercises are to be presented.

The first division of the examination is both written and oral. The written examinations all take place within a few days (again in contrast to Prussian arrangements, where they extend over months), and are arranged in three groups:

GROUP 1:

(*a*) Elementary plane and solid geometry (2 hours).

(*b*) Plane and spherical trigonometry with simple applications to mathematical geography (2 hours).

(*c*) Descriptive geometry, including the elements of axonometry and perspective with applications, e. g., to construction of shadows (drawing very carefully done) (2–3 hours).

(*d*) Algebra (2 hours).

GROUP 2:

(*a*) Analytic and synthetic plane and solid geometry (2–3 hours).

(*b*) Differential and integral calculus with applications (2–3 hours).

(*c*) Elements of the theory of ordinary and partial differential equations and the elements of differential geometry (2–3 hours).

(*d*) Theory of series and elements of the theory of functions (2–3 hours).

GROUP 3:

(*a*) Experimental physics, Division I (mechanics, acoustics, theory of heat) (2 hours).

(*b*) Experimental physics, Division II (electricity, magnetism, optics) (2 hours).

(*c*) Analytic mechanics of rigid and deformable bodies (2–3 hours).

(*d*) Elements of theoretical physics (2–3 hours).

In addition to these written examinations, the candidate is given four hours to write a German essay to test his general culture. The subject of the essay must be selected from one of three fields stated to him.

The elaborate home essay, which is the central feature of the written examination in other States and which is regarded as of special value in determining cultural development, is entirely lacking in Bavaria.

In the oral examination, which is not public, there is more searching questioning in certain fields of the written examination; these fields include the foundations of the theory of space (Group 1), the theory of numbers (Group 2), and chemistry (Group 3). The candidate is also given opportunity to prove his familiarity with some special field of mathematics or physics which he has himself chosen.

The oral examination in each of the groups 1 and 2 lasts for 40 minutes; in group 3, 50 minutes.

Between the first and second divisions of the Lehramtsprüfung the candidate receives his practical or professional training in a Seminar, to which he is assigned by the ministry. The training here has been described already.

In the second division of the examination the candidate—

(*a*) Presents his home thesis.

(*b*) Gives lessons of one hour each in some topics of mathematics or physics (in connection with which opportunity is given to indicate his facility in sketching on the blackboard and in experimentation), and conducts an exercise in physics for pupils. The topics are assigned one day in advance.

(*c*) Is examined orally on the theory of education and instruction, especially of secondary school pedagogy and its history, as well as on related fundamental questions in philosophy and psychology. In addition to the general knowledge, the candidate must show a more thorough acquaintance with the pedagogic theories and cultural development in some modern epoch selected by himself. Connected with this are questions on the newer development of methods of instruction in topics of mathematics and physics, whereby the candidate is given an opportunity to demonstrate his acquaintance with separate phases of development in mathematics and physics.

A candidate who fails in the second section of the examination must repeat the Seminarjahr before he is permitted to try the examination again. A second repetition of the examination is not permissible. The examination is conducted almost entirely by schoolmen, including the Seminar director and Seminarlehrer.

The optional "special examination" was a feature of regulations in force from 1873 to 1895. In somewhat modified form it reappeared in 1912. This examination must be taken within 10 years after the second division of the Lehramtsprüfung; it may, however, be taken at the same time or even before, but in this latter case a certificate of having passed the examination will not be awarded until the Lehramtsprüfung has been completed.

For admission to the special examination, there is required either the presentation of a scientific thesis [1] in the field of pure or applied mathematics or of physics, or the presentation of a practical work, with proof of thorough scientific study in one of the following fields: Geodesy, astronomy, technical mechanics, technical physics, electrotechnical science.

The first part of the oral examination is on the field from which the subject of the scientific thesis is taken and lasts about an hour; the second part covers the whole range of the special subject chosen and lasts at least an hour and a half. No second trial of this examination is permissible.

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[1] Or prize essay or doctor's dissertation or other printed paper.

Note that a scientific thesis and a piece of practical work are put on a plane of equality in this examination, of which there is no analogue elsewhere in Germany, although it is somewhat similar to the examination for doctorate. In the earlier regulations it was ordered that those who passed the special examination, even though it involved nothing of a pedagogic character, were to get the better positions in the secondary schools. This is not necessarily the case in the newer regulations, and just what the effect of the examination will be, remains to be seen.

In illustration of the excellence of the pedagogically arranged lists of courses offered at the University of Munich, that for the summer semester 1914 is given: Introduction to higher mathematics for students of philosophy (3 hours, including one for exercises), Dingler; differential calculus (5 hours, including one for exercises), Böhm; exercises in plane analytic geometry (2 hours), Dingler; descriptive geometry II (5 hours), Hartogs; exercises in descriptive geometry (3 hours), Hartogs; analytic geometry of space (4 hours), Voss; integral calculus (5 hours), Lindemann; definite integrals and Fourier series (4 hours), Pringsheim; synthetic geometry II (4 hours), Rosenthal; exercises in synthetic geometry (1 hour), Rosenthal; in seminary, exercises for middle semesters (higher analysis with applications) (2 hours), Rosenthal; theory of algebraic forms (invariants) (4 hours), Lindemann; introduction to the theory of partial differential equations (4 hours), Voss; seminary, theory of ordinary differential equations (2 hours), Voss; applications of elliptic functions (3 hours), Pringsheim; on the problem of squaring the circle (2 hours), Lindemann; seminary (2 hours), Lindemann; geometric morphology (3 hours), Brunn; elementary theory of life insurance for natural scientists, political economists, and mathematicians (4 hours, including one for exercises), Böhm; lectures and reviews of mathematical-statistical questions, for advanced students (2 hours), Böhm. Mechanics of the continua (hydrodynamics, acoustics, elasticity) (4 hours), Sommerfeld; seminary exercises on hydrodynamics, etc. (2 hours), Sommerfeld; physics of the science of earthquakes (4 hours), Bidlingmaier; mechanics of the heavens II (4 hours), Seeliger.

3. SAXONY.

The regulations formulated in 1908–9 for the preparation of teachers of mathematics for the secondary schools of Saxony differ very little from those promulgated in Prussia in 1898. The examination consists of two parts, the general and the special subject. The home theses are to be finished before the oral examination. The general examination is on philosophy, pedagogy, and German literature, but not on religion. The special subject examination, more limited than in Prussia, is confined to—(1) pure mathematics; (2) applied mathematics; (3) physics; (4) chemistry; (5) mineralogy and geology.[1]

The candidate must choose at least three subjects; it is desirable that he be also prepared in a fourth; and he is not prohibited from taking all five. The following combinations are permissible:

(*a*) Pure mathematics, applied mathematics, physics.
(*b*) Pure mathematics, physics, chemistry.
(*c*) Chemistry, mineralogy with geology, physics.
(*d*) Chemistry, mineralogy with geology, pure mathematics.

For home theses the candidate is given two problems, one for the general examination, the other for the special subject examination in that subject in which he wishes to prove himself capable of first grade. In case this subject is pure mathematics he receives, in addition to the problem for the general examination, two problems for the special subject examination to work at home, of which one must be in mathematics; in this case the candidate has no written examination, but otherwise written examinations in all subjects of the special subject examination, to the extent of four hours, may be required. For the preparation of each home thesis eight weeks are allowed. The whole period of examination in Saxony as well as in Prussia thus extends over several months instead of a few days as in Bavaria.

The regulations with regard to pure mathematics and physics in the special subject examination are practically identical with those in Prussia, but in applied mathematics the requirements are somewhat different by reason of the final clause. The whole paragraph is as follows:

> Of candidates who wish to qualify for instruction in applied mathematics there is required, in addition to a certificate in pure mathematics, knowledge of descriptive geometry, including the principles of central projection, and corresponding facility in drawing; familiarity with the mathematical methods of technical mechanics, especially of graphical statics, with lower geodesy and the elements of higher geodesy and with the theory of adjustment of errors in observation. The candidate is free to indicate in which one of the three parts he would rather be examined.

The preparation for the special subject examination usually occupies not less than four years and this may be made either at the University of Leipzig or at the Technische Hochschule in Dresden. For the student whose special subjects are pure and applied mathematics and physics, the following scheme of courses is recommended at the Technische Hochschule:

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[1] There seems to be a discrepancy in A. Witting's report unless different regulations govern candidates studying at the University of Leipzig from those at the Technische Hochschule. The regulations quoted above went into effect for the Hochschule January 25, 1909 (p. 57). On p. 47, however, in connection with regulations in force May 1, 1908, for the university, German is not mentioned as a general examination subject, while nine instead of five subjects are mentioned as possible special subjects: the other four are history, botany, zoology, and geography. Geography might be elected instead of chemistry by the mathematician. *Cf.* Lorey's report on Prussia, p. 65.

1. Semester (summer).
    - Higher Mathematics I (analytic geometry and higher analysis), with exercises.
    - Descriptive Geometry I, with exercises.
    - Inorganic chemistry.
    - Inorganic chemistry in laboratory.
2. Semester (winter).
    - Higher Mathematics II, with exercises.
    - Descriptive Geometry II and perspective, with exercises.
    - Technical Mechanics I, with exercises.
    - Experimental Physics I.
    - Geodesy I.
    - Laboratory physics.
3. Semester (summer).
    - Higher Mathematics III, with exercises.
    - Analytic geometry of conics.
    - Technical Mechanics II, with exercises.
    - Experimental Physics II.
    - Praktikum in geodesy.
    - Method of least squares.
    - Laboratory physics.
4. Semester (winter).
    - Higher Mathematics IV, with exercises.
    - Analytic geometry of surfaces of the second degree.
    - Technical Mechanics III, with exercises.
    - Geodesy II.

For the first, third, and especially the fourth semester it is recommended that the candidate take yet other courses in the fields of mathematics and physics. The above-mentioned courses are simply those which are fundamental.

Later semesters should serve for deeper study in fields of interest. For this purpose there are each semester mathematical seminaries, praktika in physics, and special lectures in mathematics and physics, especially in spherical trigonometry, theory of real and complex functions, elliptic functions, higher algebra, differential equations, theory of space curves and surfaces, theory of geometric transformations, theory of algebraic curves and surfaces, geometry of motion, analytic mechanics, potential theory and other parts of mathematical physics, spherical astronomy, and insurance.

The following courses in mathematics and astronomy were offered at the University of Leipzig in the summer semester of 1914: Descriptive geometry (2 hours), by Rohn; plane analytic geometry (4 hours), Herglotz; algebraic analysis (introduction to the differential and integral calculus), Herglotz; theory of numbers (2 hours), Koebe; algebraic curves (4 hours), Rohn; differential equations, with exercises (4 hours), Koebe; general theory of functions of a complex variable (4 hours), Hölder; calculus of variations (2 hours), Hölder; theory of collective measurement (4 hours), Bruns. Mathematical seminary: (1) Exercises in theory of functions (1 hour), Hölder and ———; (2) exercises in descriptive geometry (2 hours), Rohn and ——; (3) exercises in algebraic-curves (1 hour), Rohn; (4) introduction to the literature of modern theory of functions (conformal representation and uniformization), lectures by the members (fortnightly), Herglotz and Koebe. Exercises in analytical geometry (1 hour), Herglotz; practical work in the observatory, Bruns.

Further, all candidates have opportunity to hear, at regular intervals, lectures on history of philosophy, logic, psychology, systematic pedagogy, and history of pedagogy.

In spite of the statement of P. Ziertmann in Monroe's Cyclopedia (p. 91), I am in doubt as to whether the Probejahr is obligatory [1] in Saxony, since even the Seminarjahr does not seem to be required but only "recommended." (A. Witting, p. 62.) The single Saxony Seminar for the mathematician is the practical-pedagogic Seminar which was organized in 1895 and stands in official connection with the University of Leipzig.[2] It is in charge of the rector of the Thomas Gymnasium, and Dr. Ernst Lehmann directs the work of mathematics and natural sciences. The weekly sessions of two hours each in a Gymnasium embrace visiting the classes of experienced teachers, practice teaching by students, and criticism of the work done. The number of students is large.

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[1] It is not even mentioned by A. Witting, in connection with the required training of the teacher. True, one does find the following in section 8 of the regulations concerning the practical Seminar mentioned below: "Upon his departure from the Seminar every member can demand a certificate, which is to be given by the leader of the subject group and countersigned by the director. These certificates must be affixed to the petition to the royal ministry of public instruction when the candidates are admitted to the Probejahr." (J. F. Brown, p. 112.)

Upon appealing to the late Miss Anna T. Smith, specialist in foreign educational systems at the Bureau of Education, Washington, for references leading to a more conclusive statement, I received the following information:

"I regret to say that I am unable to refer you to any sources of information which positively settle your inquiry, although to my mind it may be inferentially determined. A little volume by Prof. Dr. Jacob Wychgram, entitled *Das höhere und mittlere Unterrichtswesen in Deutschland*, and published at Berlin and Leipzig in 1913, purposes to give the requirements existing at that time with reference to the qualifications of teachers of the secondary schools in Germany. In the introductory chapter, which is a general survey for the entire Empire, p. 25, it is stated that after completing the *Seminar and Probejahr* the candidates receive the certificate of capacity for appointment as professors and may be admitted into the public, State, or city school service unless special difficulties interfere. This statement is in exact accordance with the requirements published for Prussia in 1898, i. e., Ordnung der Prüfung für das Lehramt an höheren Schulen von 12. September, 1898.

"By a decree (Verfügung) dated Dec. 29, 1892, a mutual arrangement was entered into between different parts of the German Empire which provided for the mutual recognition of candidates in the States of the Empire named. The Kingdom of Saxony does not appear in the number. [Compare pp. 86–87.] It is known that, while the general features of the Saxon scheme of qualification are the same as those of Prussia, there are some slight modifications. This distinction is indicated by regulations pertaining to the examination of candidates for the higher school service issued Jan. 25, 1909. Section 29 of this publication simply states that the candidate for appointment, before receiving the certificate of capacity, must have sustained the State examination and have passed successfully the Probejahr. No mention is made of the year in the Seminar. From this it might be inferred that the latter is not essential, although it is well known that it is customary. (See Bekanntmachung, über die Ordnung der Prüfung für Kandidaten des höheren Schulamtes der mathematisch-physikalischen und chemischen Richtung an der Königlichen Technischen Hochschule zu Dresden, sec. 29, pp. 14–15.)"

[2] "Uber das Studium der Pädagogen an der Universität Leipzig," in Klein's *Aktuelle Probleme der Lehrerbildung*, pp 16 ff.

4. WURTTEMBERG.

The present regulations for the training of teachers for secondary schools date from 1898. Broadly speaking, they require that a candidate shall successfully pass (1) two service examinations (*Dienstprüfungen*), that is, examinations preparatory to serving as teachers; and (2) a "Vorbereitungsjahr" or Probejahr.

The examinations are held at Stuttgart, usually in the spring, before a commission composed of university professors and schoolmen appointed by the minister of church and school affairs. The commission is under the direction of a member of the department of the ministry for higher schools.

Application for admission to the first service examination must be accompanied by: (a) A scientific thesis; (*b*) proof of attendance at lectures and seminary exercises in a German university or technical high school during four years; (*c*) certificates of participation in the exercises of a high-school institute in physics or chemistry, and a testimonial descriptive of the success attending this participation.

Of the required attendance at university and technical high school at least two of the semesters must be at a university, and during not less than six semesters the candidate must specialize in the subjects of examination, in class and seminary.

Two advanced lecture courses in philosophy and one in pedagogy are also required of all candidates.

The first service examination of the mathematics-natural science course is arranged in two divisions: (*a*) Mathematics-physics; (*b*) chemistry-biology, between which the candidate has to make choice. The subjects in each division are grouped as majors and minors.

Except in cases to be noted presently the examinations are both written and oral in all subjects; the commission can nevertheless waive oral examination of a candidate in a special subject, when he has done exceptionally well in the written examination.

The majors in the mathematics-physics division are:

1. Mathematics.
    - (*a*) Higher algebra, including the theory of elimination.
    - (*b*) Differential and integral calculus, including partial differential equations and elements of the theory of functions.
    - (*c*) Analytic geometry, including the elements of the theory of higher curves as well as the theory of curvature.
    - (*d*) Trigonometry, with mathematical geography.
    - (*e*) Synthetic geometry, including surfaces of the second degree.
    - (*f*) Descriptive geometry.
2. Mechanics, especially mechanics of a rigid system.
3. Physics.
    - (*a*) Experimental physics.
    - (*b*) Theoretical physics in the four fields: Mechanics in physics, optics, theory of heat, electricity and magnetism (written examination only).
    - (*c*) Exercise in manipulation of apparatus for physics.

In the written examination the candidate is expected to solve one or more of the "not too difficult exercises" of the subject in question, while in the oral examination the candidate's comprehension of the theory is ascertained.

In mathematics, the candidate has a choice in the written examination between (*a*) and (*b*); in theoretical physics exact acquaintance with only two of the four fields mentioned is required.

The exercise in manipulation of apparatus consists in carrying out certain experiments; the commission may waive this exercise if an official certificate from the authorities of the Institute of Physics or of the State University, or of the Technical High School in Stuttgart indicates sufficiently long drill and adequate dexterity in such exercise.

The only minor of the first part is chemistry, in which a knowledge of the most important theories of general chemistry and acquaintance with the presentation and the properties of the most important compounds is required. Furthermore, demonstrations suitable for school instruction may be called for.

The majors of the chemistry-biology division are chemistry, mineralogy with geology, botany, zoology.

The minors of this part are:

1. Algebra and lower analysis.
2. Elements of differential and integral calculus.
3. Elementary geometry, including trigonometry and the elements of modern geometry.
4. Elements of plane analytic geometry.
5. Elements of descriptive geometry.
6. Experimental physics, in which the demonstration of acquaintance with the most important apparatus for instruction in physics may be required.

Mathematical questions which have been set in Wurttemberg examinations in both the mathematics-physics and the chemistry-biology divisions are given in Appendix E.

For upper classes the teacher is allowed to instruct only in the subjects of his first service examination; in the two upper classes he must usually confine himself to the major subjects of this same examination.

Concerning the second service examination the regulations state: After the first service examination the candidate is assigned to a Realschule for a year in order to acquire a methodical introduction into the theory and practice of teaching (Vorbereitungsjahr). The second service examination consists of (*a*) a German essay; (*b*) an examination in free-hand drawing; (*c*) a supplementary examination (Ergänzungsprüfung), in which the extent of the requirements is determined by the needs of instruction in middle *real* classes; and (*d*) the delivery of three trial lessons.

The peculiar supplementary examination of the mathematics-natural science group includes (1) French and (2) English, and is a survival of other days. In practice, however, the young teacher equipped to instruct in mathematics has to start out in a country school and possibly instruct in just such subjects.

The Vorbereitungsjahr is never properly practical because of the great scarcity of teachers. Hence the professional training of the teacher in Wurttemberg really amounts simply to a year of teaching.

At the University of Tubingen in the summer semester of 1909 the following lectures were given: General psychology (4 hours a week); church and school in the nineteenth century. In the winter semester, 1909–10: Psychology (4 hours a week); philosophical ethics and jurisprudence (4 hours); exercises in ethical questions (1 hour).

5. BADEN.

The examination ordinance of 1903 for teachers in secondary schools in Baden is copied in its essentials from the Prussian of 1898.

Before admission to the examination the candidate must have pursued special studies at a German university for not less than eight semesters (instead of six). If mathematics or natural science is to be the major of the examination, regular study at a German school of technology may be counted equivalent to study at a German university up to four semesters (ordinance of 1909). During at least four semesters of the period of academic study the candidate must have successfully participated in scientific or practical exercises in school of technology or university seminaries, or laboratories, or institutes.

The examination, which occurs every spring in Karlsruhe before a special commission, consists of two parts, the general and special subject examinations. Both are written and oral; the written usually precedes the oral.

The subjects for examination are:

A. In the general examination for each candidate, (1) philosophy, (2) German literature.

B. In the special subject examination, according to the choice of the candidates: In the mathematics-natural science field of instruction: (1) Mathematics,[1] (2) physics, (3) chemistry and mineralogy, (4) botany and zoology.

Geography may be chosen in combination with mathematics, zoology, and botany, or as another subject.

The candidate must choose at least three examination subjects—two as majors and a third as minor.

Candidates in the mathematics-natural science division must always choose mathematics. The candidate with mathematics as a major must present a certificate indicating his participation in the exercises of a university seminar or other school of higher education during at least four semesters.

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[1] Applied mathematics does not occur as a special examination subject.

In the general examination all candidates must demonstrate—(*a*) Their general knowledge of the most important facts in the history of philosophy, the principles of logic, and the chief facts of empiric psychology; (*b*) their acquaintance with the general development of German literature from the beginning of its "blooming period" in the eighteenth century; (*c*) their thorough knowledge of a not too limited field in philosophy and literature.

For the examination in mathematics there is required—

(A) As minor: Knowledge of the elements of higher analysis, plane analytic and synthetic geometry, spherical trigonometry, elements of astronomy.

(B) For mathematics as major in addition to the knowledge required in A: Acquaintance with the foundations of arithmetic and geometry, of analysis and algebra, including the theory of functions, of analytic and synthetic geometry of space, and of analytic mechanics, as well as with the elements of descriptive geometry and with the chief facts of the history of mathematics.

For the home theses every candidate receives two problems, one for the general examination, the other for the special subject examination in one of the subjects chosen by the candidate as major. The examination commission may, however, so choose a theme that the latter home thesis involves both majors.

For the preparation of the two home theses a period of 20 weeks is allowed.

The extent of the requirements in this connection may be judged by some of the themes assigned in the years 1908 and 1909:

Derive the necessary and sufficient conditions for the validity of the theorem concerning the independence of the value of the integral $w = \int_{z_0}^{z} f(z)dz$ taken over the path of integration, and apply the theorem to some examples (Cauchy) for finding the value of definite integrals.

Symmetric functions.

The proofs of the transcendence of π exhibited in their characteristic features.

Connection between the theory of functions and hydrodynamics, especially explanations of Kirchhoff's theory of waterspouts.

A presentation of the most important theorems in the theory of cylindrical functions.

The addition theorems of elliptic integrals of the first, second, and third species according to Euler's development, and their principal geometric applications.

The derivation of Lagrange's differential equations of the second kind in mechanics after the presentation of Boltzmann and the researches of Von Hölder on the Hamiltonian principle.

Development of the most important properties of spherical harmonies according to the lectures of Helmholz, due regard being paid to the works by Heine, F. Neumann, and C. Neumann.

On the numerical solution of algebraic equations.

On the transformation of Laplace's differential equation of the potential by Jacobi, among others, together with applications to individual problems.

On those plane curves of the fourth order which have the imaginary circular points at infinity as double points.

On singular asymptotic curves and surfaces (Inaugural dissertation).

Cyclides.

A prize memoir crowned by the faculty of philosophy or natural science in a State high school or university, or a dissertation accepted by such a faculty may be considered by the examination commission as equivalent to the home thesis in the special subject examination.

In determining the result of the whole examination slight lack of knowledge in one part may be compensated for by good performance in another. The candidate has passed if he has met the requirements of the general examination, is satisfactory in at least one of his chosen majors, and has shown a knowledge of two more subjects at least equivalent to that required for minors. If the examination is passed, one of the predicates "satisfactory," "good," or "excellent" is assigned, according to the character of the written and oral examinations and home theses. In this connection the majors are to be considered as first in importance, the minors and general examination as secondary. If the candidate has failed in his examination, he may try again within two years, at the latest. If he fails a second time, permission for further trial may be granted only by the ministry.

Having passed the examination the candidate must next become a *Praktikant* in the training of a "Probejahr" which is more in the nature of a Prussian Seminarjahr.

The activities of the Praktikant in the institution consist—(*a*) In visiting classes which will aid in his development; (*b*) in trial teaching, first for part of a lesson, then for whole lessons, and finally for continuous instruction; (*c*) in study of notable works in general and special pedagogy and didactics, which are to be found in the library of the institution. This study is directed by the teacher in charge of the candidate.

From this teacher at the beginning of the second half of the year the Praktikant receives a theme on which he has to prepare a thesis of not more than 20 written quarto pages in extent. This theme relates to the activities of the Praktikant in the institution, but its treatment also serves to indicate his knowledge of the related pedagogic literature of ancient and modern times. The thesis, accompanied by the critical judgment of it on the part of the director of the institution, is laid before the inspector.

Furthermore, the Praktikant has to give a trial lesson to a class, which he has taught consecutively for at least two weeks, before the director of the institution and the guiding teacher. These each make independent reports of the trial lesson to the inspector. The report of the director is also accompanied by a statement concerning the candidate's industry and his general bearing both inside and outside of the institution.

On the basis of the various reports the inspector decides on the candidate's qualifications as a teacher. If he decides that the requirements of the "Probejahr" have not been met, the probationary period may be extended for a year.

At the University of Freiburg in the summer semester of 1909, the following courses were offered: Psychology (4 hours a week); physiological psychology (1 hour); history of pedagogy (2 hours). In the winter semester: Physiological psychology (1 hour); the higher school systems of the present (2 hours); school hygiene (1 hour).

In corresponding semesters at the University of Freiburg the following courses were offered: Ethics (5 hours a week for a semester); pedagogical classics, Rousseau and Pestalozzi (1 hour a week).

As in Bavaria, university "vacation courses" are given from time to time. For example, at Freiburg, Easter, 1906: Löwy lectured on mathematics of life insurance, and Lüroth on some fields of infinitesimal calculus which are suitable for introduction into instruction in secondary schools. At Easter, 1908, Lüroth gave three lectures, of an hour each, on spherical trigonometry.

6. ALSACE-LORRAINE.

Since 1899 the regulations for the scientific training of the teacher for the secondary school have been the same as those of Prussia.

The examination is conducted at Strassburg by an imperial scientific examination commission.

The professional training of the teacher in Alsace-Lorraine has not changed in form since 1871. The young expectant is sent as "probationary candidate" to some higher school where he is required to give instruction for six or eight hours weekly. The pédagogic and didactic direction, the fixing of class hours when the candidate listens to the instruction of other teachers, the giving of advice in the choice of works which serve to advance pedagogic and didactic development, are either undertaken by the director, if he is a specialist in mathematics, or (as happens more frequently in larger institutions) by a capable teacher who exercises a more or less satisfactory guidance. At the end of the Seminarjahr the candidate must present a thesis on a theme given him in the first half of the year. As usual in such cases the theme gives the candidate an opportunity to treat some practical pedagogic question on the basis of his own teaching experience and of his study of related literature. The reports to the inspector are of the same nature as in Baden, and he decides as to the candidate's "Anstellungsfähigkeit."

Wirz well remarks: In this organization for the training of candidates, it is evident that chance plays altogether too prominent a rôle.

When Reye and Weber were at the university of Strassburg the courses of lectures were arranged according to a plan which considered the needs of those preparing to be teachers in secondary schools. In the list of courses for the summer semester of 1914, however, there is little evidence of any such plan, as there is only one course, on the theory of numbers, which can be possibly considered as a course for beginners. The list is as follows: By Faber: Integral calculus II (4 hours); theory of numbers (2 hours); mathematical seminary (the distribution of prime numbers) (2 hours). By Schur: Theoretical mechanics (4 hours); theory of ordinary differential equations (2 hours); mathematical seminary (2 hours). By Simon: History of mathematics in the Middle Ages (2 hours). By Wellstein: Elliptic and hyperelliptic functions (4 hours). By v. Mises: Technical mechanics II (hydraulics and aerodynamics) (4 hours); integral equations and their applications (4 hours); seminary exercises in applied mathematics (technical mechanics) (2 hours). By Epstein: Calculus of variations (2 hours). By Speiser: Theory of aggregates (2 hours); the equation of the fifth degree with exercises (1 hour).

Arrangements for the scientific development of the teacher of mathematics are wholly lacking and there are no "vacation courses" as at several universities in Prussia, Baden, and elsewhere.

In the summer semester of 1909 and the winter semester of 1909–10 the following courses were given at the university of Strassburg: Psychological exercises (2 hours a week through a semester); history of philosophy (2 hours); psychology (4 hours); introduction to experimental psychology (1 hour); ethics (2 hours); history of Greek ethics (2 hours).

7. HESSE.

According to an ordinance of 1908 the scientific capabilities of a candidate are tested by an examination commission at the University of Giessen. The commission is composed only of professors in the faculties of philosophy and theology, the idea being that after candidates have studied at the university their teachers are best qualified to examine them. In addition to the examination, a professional training of two years is required.

Candidates for admission to the examination in mathematics and natural science—(*a*) must have a Reifezeugnis from a Gymnasium, Realgymnasium, or an Oberrealschule; (*b*) must have attended a German university for at least eight semesters, three semesters at a technical high school being counted as equivalent to those at a university.

The examination consists of a general examination and a special subject examination. The general examination is on philosophy, pedagogy, and German literature. In philosophy a home thesis is required, six weeks being assigned for completing it; otherwise the examination is oral. It is expected that the candidate have a general knowledge of the history of philosophy, acquaintance with the most important laws of psychology and of the facts of empiric psychology, and also familiarity with the history of pedagogy, the essentials of method (Methodik), and with the general development of German literature.

The regulations with regard to the special subject examination are almost word for word the same as those in Prussia.

The first of the two years of professional training must be obtained at one of the six pedagogic Seminarien connected with and conducted by the officials of some of the secondary schools. Candidates are here familiarized with the pedagogic theories required in their special scientific development for the purposes of instruction and education, and are guided in the practical application of knowledge thus won. This training takes place (1) at meetings which occur once or several times each week for introductory instruction in the theoretical pedagogy and method of individual subjects; (2) in the classroom, where the candidate first observes the instruction of a special subject teacher and then after sufficient preparation and assistance gives some trial lessons. At the end of the Seminarjahr each candidate must present a thesis on a pedagogic subject.

The second year of professional training is at one of the secondary schools, where the candidate gives consecutive instruction under the direction of one of the teachers or of the director. After successfully meeting the conditions of professional training the candidate, who has up to that time borne the title of *Lehramtsreferandar*, is named *Lehramtsassesor*.

At the University of Giessen in the summer semester of 1909 and the winter semester of 1909–10 the following courses were offered: Exercises in experimental psychology; history of education and pedagogy since the age of humanism (3 hours per week); the nature, origin, and development of speech (2 hours per week); Pestalozzi in philosophic seminary (1 hour); psychology of will (1 hour); introduction to scientific works in the sphere of psychology and pedagogy; ethics; outlines of pedagogy (2 hours per week).

8. HAMBURG.

For the training of their teachers for secondary schools the Hanseatic cities of Hamburg, Lubeck, and Bremen are governed by the regulations in Prussia. The scientific training of the prospective teacher for these States, as well as the professional training in the case of Bremen, takes place in other States, such as Prussia or Hesse. I shall, therefore, confine my comment to the professional training of the candidate in Hamburg.

The candidate in mathematics and natural science is assigned, as a rule, to an Oberrealschule or a Realgymnasium. The number of Seminar candidates at one institution varies from 4 to 12. Each candidate is assigned to an experienced teacher in his special subject. This Oberlehrer decides what lessons the candidate must attend in order to prepare him most quickly to give instruction himself. The period of simple listening rarely exceeds two weeks; then follow the first attempts at teaching in the presence of the Oberlehrer. A candidate showing some aptitude gives one or more lessons alone, even during the first quarter of the year, that he may display his powers of preserving discipline. Not till this chrysalis stage has passed does the director listen to a candidate's lesson and discuss it with the Oberlehrer. Such conferences are frequently repeated. Interruption of a lesson by Oberlehrer or director rarely occurs, as it is recognized that the loss suffered by the candidate's authority is greater than the benefit which would accrue. Moreover, at the end of the lesson there is ample opportunity to point out any error. In case of need a written preparation for the next lesson may be required. It is arranged that the candidate gives at least four such inspected lessons, so-called "Anleitungsunterricht," weekly.

At the same time, in accordance with the advice of the Oberlehrer, he visits classes, first, in all grades of his own special subject, then also in other school subjects to a moderate extent. He has to render an account of his activities to the director every week. In some institutions a written report of lessons heard and given is required. This proceeds by way of the Oberlehrer, who suppresses indiscretions or evidences of poor judgment. Since in a large faculty frequent substitutes (Vertretungen) are necessary, the candidate is early and frequently called upon to act as deputy. In these cases he is quite alone and must report to the Oberlehrer what he has done. The weekly amount of Anleitungsstunden, hours of visiting classes, and Vertretungsstunden should not exceed 18 and usually varies between 12 and 15 hours.

In the second quarter the candidate gives frequent instruction in one or two classes of different grades. He must direct practical class exercises in physics unassisted. If a class is divided into two sections for carrying out exercises, it is customary for the Oberlehrer to take the first section, while the candidate assists in the lesson. The candidate then conducts the second section himself. When the candidate has the necessary independence, especially with respect to discipline, the attendance of the Oberlehrer during his teaching hours is confined more to regular visits.

In the second semester regular teaching hours are frequently assigned to the candidate, and for these he receives remuneration. In addition to this he retains Anleitungsunterricht in one subject.

In the Seminarjahr the candidate must become thoroughly acquainted with the school equipment, and the laboratory exercises give the necessary incentive. In addition all Seminar candidates of physics are required to attend the weekly instruction (2–3 hours) in practical physics in the Oberrealschule at the Uhlenhorst.

For theoretical instruction a conference of one hour a week is appointed. This is led by the director. So far as possible, general questions of instruction and education are dealt with by discussion. Experienced specialists lecture on methods of instruction in individual subjects; discussion follows immediately or a week later in the presence of the lecturer. Every candidate must present a review of some valuable work; for example, by Locke, Basedow, Pestalozzi, Herbart, Jäger, Förster, Wernicke, Lietz, Wetekamp, Reidt, Simon, Schwering, Klein, Wellstein, Killing, or publications of the International Commission on the Teaching of Mathematics. The zealous use of the Seminar library is promoted by the director. In some institutions the minutes of the Seminar conferences are taken by the candidates in turn. At others each candidate has to prepare minutes of all general or special conferences.

The candidate has to take part in all conferences and class examinations in so far as he is not prevented by his own instruction. When the reports of these examinations are decided upon by class teacher and director, the candidate has the right to offer a dissenting opinion; indeed, he is expressly summoned to declare himself, if the higher courts disagree.

At the end of the Seminarjahr the candidate must present a scientific pedagogic thesis, and a more practical report on his total teaching experience is due at the end of the Probejahr. In the Probejahr the candidate is usually busy with a large amount of remunerative teaching. If he remains at the same institution as that in which he spent the Seminarjahr, the directing Oberlehrer is frequently changed in order that different methods may be learned. Monthly revisions by the Oberlehrer and a thorough examination of the classes by the director at the end of each semester are the rule.

The inspector follows the development of the candidates with special attention. At each of his visits to the institution, or when the director appears before the school authorities, all candidates are discussed in detail. Special occurrences are immediately communicated either orally or in writing. The inspector hears the candidate at least once in each semester, and considerably oftener if doubt arises as to the desirability of admitting him to the Probejahr or of awarding him an Anstellungsfähigkeitszeugnis. On the basis of his own observations, of repeated oral reports by the director, and of written final reports by the Oberlehrer and director, the inspector passes upon the candidate's fitness for the Probejahr or for a teaching certificate. The refusal of the first as well as the second occurs repeatedly, either by postponement (when the work is usually continued at another institution) or with finality.

In conclusion, some titles of seminar theses may be mentioned. The related literature is collected by the candidate from Rethwisch's *Jahresberichten über das höhere Schulwesen*, and the director then furnishes the more important original works for thorough study. The problems are so chosen that the candidate has opportunity to test theory in practice or to modify it. Since he receives the theme in the first month, and does not render the thesis till the ninth, ample time is allowed to assemble personal experiences. The titles are as follows:

What limitations can be imposed on arithmetic-algebraic instruction in the secondary school classes?

On what grounds can the constant use of oblique parallel projection be recommended in commencing the instruction of descriptive geometry?

How far can and how far should arithmetic in the lower classes of the higher schools prepare for the instruction in algebra?

What part of the theory of circles may be placed at the beginning of instruction in plane geometry?

Geometrical instruction in Quarta, with special reference to M. Schuster's *Geometrische Aufgaben.*[1]

How may instruction in spherical trigonometry be built up on the theory of right, angled dihedral angles as found in solid geometry?

The treatment of the integral calculus in Oberprima, starting from definite integrals.

Logic in the program of the Oberrealschule.

How formulate in Sekunda the treatment of trigonometry that has the closest possible connection with plane geometry?

To what extent is history of philosophy connected with instruction in physics and chemistry?

The instructional value of drawing.

Induction and deduction in geometric instruction.

When a candidate for a teaching position in a secondary school takes up the work of his preparation in the German university he is not without suggestions for his guidance. Two illustrations of weighty pronouncements of this nature may be indicated: I. The plan recommended in 1907, after three years of labor,[2] by the commission on instruction of the Gesellschaft deutscher Naturforscher und Ärzte (resulting in the formation of the Deutschen Auschusses für den mathematischen und naturwissenschaftlichen Unterricht); II. Advice (Vorschläge) issued in 1913,[1] at the University of Gottingen, to students of mathematics and physics.

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[1] *Geometrische Aufgaben and Lehrbuch der Geometrie*, Nach konstruktiv-analytischer Methode bearbeitet. Nach dem Tode des Verfassers herausgegeben von W. Lietzmann. Ausgabe A: für Vollanstalten, 3 Teile, Leipzig, Teubner. I. Teil: *Planimetrie*, 3. Auflage, 1908, 168 pp.; II. Teil: *Trigonometrie*, 2. Auflage, 1911, 126 pp.; III. Teil: *Stereometrie*, 2. Auflage, 1908, 110 pp.

[2] Cf. A. Gutzmer, *Die Tätigkeit der Unterrichtskommission der Gesellschaft deutscher Naturforscher und Arzte.* Leipzig, Teubner, 1908. The plan and recommendations were also published in *Universität und Schule, Vorträge auf der Versammlung deutscher Philologen und Schulmänner zu Basel, 1907.* Leipzig, Teubner, 1907. See also W. Lorey, *Das Studium der Mathematik an den deutschen Universitäten*, pp 294–296.

I. In this plan it is recommended that the general studies in mathematics and physics should be taken during the first six semesters according to the following scheme:

Semester.	Specialty studies.			General studies.
1	Differential and integral calculus, I.	Analytic geometry.	Experimental physics, I.	
	Exercises, Praktika,[1] Seminaries.			
2	Differential and integral calculus, II.	Descriptive geometry (with projective geometry).	Experimental physics, II.	
	Exercises, Praktika, Seminaries.			
3	Differential equations.	Elementary mechanics (with graphical and numerical methods).	Introduction to chemistry.	
	Exercises, Praktika, Seminaries.			
4	Algebra with theory of numbers.	Curves and surfaces.	Higher mechanics.	History of philosophy and pedagogy.
	Exercises, Praktika, Seminaries.			
5	Theory of functions.	Curves and surfaces. Surveying with calculus of probabilities.	Theoretical physics, I.	Logic.
	Exercises, Praktika, Seminaries.			
6	A comprehensive lecture.	Astronomy with geophysics.	Theoretical physics, II.	Psychology.
	Exercises, Praktika, Seminaries.			

[1] In the *Praktikum* of a German university or technische Hochschule instruction is not confined to informative lectures, but includes guidance in practical application of the knowledge gained, as in laboratory work for physics and chemistry, case procedure for law, and so on.

In addition to this there will be added in most cases two to four semesters during which—

the industrious student finds time to complete these studies in some direction which appeals to him. Above all it is of importance that he deepen his study in some special field, in which it may well happen that he is led to the doctorate. Candidates with other gifts will strive for a suitable extension, not too far-reaching, of the "specialty studies" in the scheme outlined above.

As the most essential point of this scheme one may well put forward the manifestly impelling effort to make the mathematical training of the average candidate as far as possible independent of the special fields of investigation standing for the time being in the foreground of interest.

II. The Gottingen Vorschläge.

The employment of years of study for the acquisition of a general training, by virtue of which the candidate may later understandingly become a part of the whole organization of the school in which he has to work, and may have the ability to make himself potently felt in his department, is indeed a very important matter. Important, too, is appreciation, for the time being, of the pedagogic problems which stand in the foreground in the later activity of his calling.

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[1] *Ratschläge für die Studierenden der Mathematik und Physik an der Universität Göttingen*, Leipzig, Teubner, 1913, pp. 30–31. See also *Jahresbericht der deutschen Mathematiker-Vereinigung*, Band 22, 1913, pp. 99–100, and W. Lorey's *Das Studium der Mathematik an den deutschen Universitäten*, pp. 291–292.

In connection with these matters, however, there are two contrary conceptions.

The one, sustained more by historical tradition, understands general training as knowledge of an encyclopedic nature, as it were, of just those fields which are far removed from the special studies in mathematics and natural science, such as historical, literary, or even artistic phases of human development. According to this conception the pedagogic instruction puts in the foreground the general ideas which have been suggested in the course of history with regard to the problems of education.

The other more modern conception demands that the candidate in mathematics and natural science shall be in a position to establish the significance of his mastery of a particular field of instruction. In this sense we must refer to the importance which mathematics and natural science possess for the logical and theory of knowledge side of philosophy, for psychology, for history of civilization and technology, for geography, finally for the general field of civic interests. The biological side of natural science is, besides this, the basis of the rational theory of health, and it has to that extent also a quite particular importance for school management. Corresponding to this conception it would be desirable that the candidate at the university should soon acquire a certain understanding as to the significance which his scientific studies possess for the didactics of his subsequent field of instruction. On the pedagogic side, however, the great and important field of child study opens up.

At the present time examination procedure always follows the first of the conceptions. We would not, however, omit to mention the other which is ever gaining currency. We do not recommend definite lectures or Praktika in one or the other direction; rather do we believe that very much which is worthy of attainment here is better obtained by private study or, in some cases, by association with those who have a similar purpose. Whichever course the candidate may follow, we urgently recommend that during the years of his university study he shall not lose sight of the importance of the formation of his own style and delivery, and in any case shall attain as great knowledge as is requisite to the successful pursuit of his studies. We must also think of and observe the necessity for physical exercises so that on the side of the management of instruction special weight be laid upon the acquisition of ability to give instruction in gymnastics.

On account of conflict of statements in authoritative sources, it seems well here to formulate definitely the observation that even the *general* requirements for the training of teachers of mathematics in secondary schools are not the same for all the eight States we have specially considered. Prussia, Alsace-Lorraine, and Hamburg each require not less than three years of study in a university or school of technology, but all the other States require not less than four years.[1] All States except Wurttemberg, apparently, now require a Seminarjahr; this has been true of Bavaria only since 1912, and there is some doubt regarding Saxony. The Probejahr is not required in at least three of the eight States. In Wurttemberg the so-called Probejahr is simply a year of teaching. Statements made to the effect that two years of professional training are required of all German teachers in secondary schools must therefore be accepted with considerable reserve; at least four States do not have two years. The facts may be exhibited in tabular form. Note that the requirements in Hesse are more extensive than those in the other States.

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[1] According to a new Prussian project, which had been formulated when the war broke out, the following changes in the training of secondary-school teachers were contemplated: (1) A minimum of four instead of three years of study at a university or school of technology; (2) instead of a major and two minors in the special-subject examination, two majors and one minor; (3) following the lead of Bavaria, an examination at the close of the professional training. (See *L' Enseignement mathématique*, tome 18, 1916, pp. 355, 356, 358; Lorey's *Das Studium der Mathematik an den deutschen Universitäten*, pp. 254–256, 296; and *Berichte und Mitteilungen, veranlasst durch die Internationale Mathematische Unterrichts-kommission*, No. X, Leipzig, Teubner, 1915, p. 56.)

States.	Least number of years required at university or technical school.	Seminarjahr required?	Probejahr required?
1. Prussia	3	Yes	Yes.
2. Bavaria	4	(1)	No.
3. Saxony	4	?	?
4. Wurttemberg	4	No	Yes (?)
5. Baden	4	Yes	No.
6. Alsace-Lorraine	3	Yes	No.
7. Hesse	4	Yes	Yes.
8. Hamburg	3	Yes	Yes.

[1] No, before 1912; yes, since 1912.

It seems a little curious if the man who has just completed his Seminarjahr in Alsace-Lorraine, where there is no Probejahr, should be immediately qualified to teach in Prussia (because of the interchangeability of certificates) when a Prussian must submit to another year of training.

Salaries in Prussia.—The following scheme of salaries went into effect in 1909:[1]

1. Salaries of Provinzialschulräte: 6,300–8,100 marks ($1,499.40–$1,727.80).[2] The increase of 600 marks comes at the end of three, six, and nine year periods of service.
2. Salaries of directors of nine-year schools: (*a*) In Berlin, 6,600–7,800 marks ($1,590.80–$1,856.40);[2] (*b*) in other cities, 6,000–7,800 marks ($1,428–$1,856.40).[2] In addition to these salaries directors receive a rent indemnity of 1,800 marks ($428.40) in Berlin and 900–1,500 marks ($214.20–$347) elsewhere. Salaries in both (*a*) and (*b*) increase by 600 marks every three years till the maximum is reached.
3. Salaries of directors of six-year schools: 5,200–7,600 marks ($1,237.60–$1,808.80).[3] The rate of salary increase and rent indemnity is the same as in 2.
4. Salaries of the Oberlehrer, teachers of science: 2,700–7,200 marks ($622.60–$1,713.60). The salary increases occur after every three years of service. The first three increases amount to 700 marks each; the next four to 600 marks each. The Oberlehrer's rent indemnity in Berlin is 1,200 marks ($285.60); in other places 560–880 marks ($133.28–$209.44).
5. Salaries of scientific assistants from whom the Oberlehrer are chosen: 2,100 marks ($499.80) for the first year, 2,400 marks ($571.20) for the second, 2,700 marks

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[1] *Statistisches Jahrbuch der höheren Schulen*, XXXIII. Jahrgang, 1912–13, Leipzig.

[2] This computation is made on the basis of 23.8 cents to the mark. These salaries each include 600 marks "pensionsfähige Zulage."

[3] These salaries each include 400 marks "pensionsfähige Zulage."

($642.60) for the third, and 3,000 marks ($714) for the fourth year. The rent indemnity for Berlin is 720 marks ($171.36); for other places 290–580 marks ($69.02–$138.04).

In other parts of Germany salaries are sometimes not quite so high (for example in Hesse), but in Hamburg directors receive as much as 13,000 marks without residence or 11,000 marks with residence, and salaries of the Oberlehrer range from 4,000 to 11,000 marks without rent indemnity.[1]

Pensions.—In practically all of the States of the German Empire the teachers of higher schools make no contribution to the State pension funds. Such pensions may therefore be considered as adding to the attractions of the teachers' positions.

If a Prussian teacher is retired after 10 years of service, he receives 33⅓ per cent of his salary. The amount of pension increases with each additional year of service; after 25 years it is 58⅓ per cent of his last salary, and after 40 years of service the maximum of 75 per cent is reached. The period of service includes time (1) spent on leave of absence; (2) in the Seminarjahr and Probejahr; (3) in military service if performed after the age of 20.

Sixteen of the German States give larger pensions after 40 years of service than Prussia does, and several States grant 40 per cent of the salary to teachers forced to retire after 10 years of service. Three States (Hamburg, Hessen, Anhalt) give the full salary in pension after 50 years of service. (*Statistisches Jahrbuch*, 1913–14.)

Prof. J. W. A. Young has calculated that a very rough approximation to the annual cash value of a Prussian teacher's assurance of a pension after 10 years of service is $222.[2] If this be added to the salaries and rent indemnities, we find that the range of income of directors is from $1,673.80 to $2,506.80; of Oberlehrer from $977.88 to $2,145.04, this last salary being the reward after 21 years of service.

Concluding comment.—Characteristic features have been outlined to indicate a fair uniformity of procedure throughout the Empire in the selection of teachers of mathematics for the secondary schools, and it has appeared that in very few of the 26 States does the standard fall below the remarkably high one set by Prussia. The possibility of this uniformity is largely caused by the standardization of all secondary schools "for the purpose of administering military privilege which is under the control of the Central Government."

In Prussia the secondary teachers as a class now form an important group in the social system of the country as the result of struggle during more than half a century for economic equality with the

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[1] For further details with regard to different States the current *Statistisches Jahrbuch* may be consulted.

[2] *The Teaching of Mathematics in the Higher Schools of Prussia*, London, 1900, p. 29. Prof. Young's statement of $224 is derived on the basis of 1 mark as the equivalent of 24 cents instead of 23.8 cents. It should also be remarked that Prof. Young's estimate was based upon a lower scale of salaries than is now in force.

Richter or judges of the lower courts. In his delightful volume on the Oberlehrer, Mr. Learned writes as follows:

> Owing to the peculiar structure of the German State, the classes of public servants are numerous, and their ranks, rights, titles, and privileges are elaborated with great nicety. The nine grades in the civil service make a fairly accurate basis for measurement of public importance, and class differences are minutely scrutinized. Now it happens that of all State officials, the judges in courts of the first instance are most closely comparable to the Oberlehrer. They are members of a court organized on the collegiate principle; they have approximately the same training as the Oberlehrer, and are not far from the latter in numbers.

It was claimed that—

> the professional qualifications, the conditions of service, and the social obligations of the Oberlehrer were fully equal to those of the Richter; that the service of the Gymnasien to society was not inferior to that of the law court; and that, primarily, for the sake of these schools, an equal rating was necessary to secure the ablest brains for the profession and to give the prestige necessary for the Oberlehrer in the discharge of his duties.

The Kaiser, Bismarck, and Paulsen were among the Oberlehrer's champions in the fight which was finally won by parliamentary decree in 1909.

The instructors in a secondary school of Prussia consist of (1) the Probandus, or candidate on probation; (2) the Hilfslehrer, or part-time instructor, who is qualified for a higher position but awaits an opening; (3) the Oberlehrer; (4) the professor; (5) the director. The title of professor is purely honorary and was granted as an offshoot of the struggle referred to above for improving the social standing of the teacher. The ministry may appoint one-third of the regular staff of the higher school to a rank equivalent to that of university professor, and all those so nominated are authorized to use the title. Although it was intended that the honor should be a reward of merit, in practice it is awarded irrespective of merit to the upper and older section of the faculty

As for the number of hours of service per week, German teachers compare well with American and English, but badly with their French colleagues. Special teachers give 26 hours of instruction per week; Hilfslehrer, 24; Oberlehrer, 22; and professors, usually 20;

> but all are liable to extra work without, as in France, extra remuneration. The teachers are expected to watch over their pupils' health, to prepare their lessons carefully and mark their exercises regularly, to consult the director before undertaking any private work and the Provinzialschulkollegium before venturing to marry, and above all to refrain from political controversy and pamphlet writing. It will be noticed that French masters, though equally civil servants, are bound by none of these petty regulations.

In addition to an almost overwhelming burden of official duties, the director must usually also teach 12 to 15 hours a week. But in spite of his great responsibilities, he is warned that even in official relations with teachers he should not emphasize the fact of his precedence. As Mr. Learned remarks, "He is but primus inter pares, and the members of the Kollegium do not allow him to ignore or forget the fact."

Although the school obligations of the Oberlehrer are arduous, it is common practice for him to supplement his small salary by private tutoring and by boarding students at his home. He can by frugal management comfortably rear and educate a large family, while constantly enjoying a sense of security in the tenure of his office and in provisions made for disability and advancing age. Moreover, his social status in the community is of importance commensurate with that of one whom Bismarck declared to be "the most important factor in patriotic education of the rising generation."

To such training, career, and rewards the candidate who presents himself for preparation as a teacher in a secondary school in Germany may look forward.

The scientific publications of professors in secondary schools consist mainly of textbooks and of discussions of methods in teaching. Among mathematicians who have produced purely scientific work during professional activity, the notable case of Grassmann may be cited.

It was formerly normal for a university professor to start his career by teaching in a secondary school. For example: Weierstrass, Clebsch, Fuchs, Kummer; and among those living, Sturm, Killing, Lampe, and Wangerin. But since about 1870 this has happened rarely At the Technische Hochschule in Berlin certain courses are given by secondary school professors, some of whom have been called to universities; for instance, Jahnke and Salkowski. At Strassburg, Simon has been both professor in a secondary school and honorary professor in the university since 1903.

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IX. HUNGARY.

Exclusive of Croatia and Slavonia, Hungary is about 109,000 square miles in extent and has a population of over 18,265,000, of which more than one-half are Hungarians (Magyars).

Hungarian education is administered, for the most part, by the ministry of worship and public instruction, which is organized in 10 departments, including the departments of elementary, secondary, and higher education. Although not all schools are controlled by the State, all are subject to State inspection.

SECONDARY SCHOOLS.

The right of inspection over all secondary schools was given by the secondary school act of 1883. Another significant feature of this law was that it gave to the national speech, the Hungarian language, its proper place in instruction by directing that it should receive attention in all school courses.

Secondary schools are divided into Gymnasia and "Real Schools." The aim of these schools is to provide boys with a higher general training, and to prepare them for the universities. The Gymnasia attempt to carry out this aim by means of a humanistic training, especially classical; the Real schools by means of modern languages, mathematics, and natural science.

The secondary school course of eight years (Classes I–VIII) is based upon the first four years of the primary school course.[1] In the Real schools, the pupil studies 9–11 subjects each year and receives 28–30 hours of instruction per week. In the whole course 30 hours per week of class work have been devoted to mathematics and 22 hours to drawing and geometry, or two-ninths of the total number of hours in the course has been assigned to these two subjects. In the Gymnasia this proportion is reduced to two-thirteenths. Here arithmetic is taught in Classes I–III; algebra, plane geometry, and plane trigonometry in Classes IV–VI; algebra, solid geometry, spherical trigonometry, and graphs in Classes VII–VIII. In the Real schools these subjects are developed at greater length, especially the section on graphs, which becomes a course in plane analytic geometry. Eight hours of descriptive geometry also come into the program of Classes VI–VIII of the Real schools.

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[1] The six-year courses of the "burgher" schools (Polgári iskolák) for boys are also based upon this course but the form and manner of instruction is that of higher elementary schools.

In Croatia and Slavonia the eight-year course of secondary education is in the Realgymnasia.

The Hungarian scheme of secondary education is almost identical, even to the programs, with that of Austria.

A public examination takes place at the close of each school year. At the end of his eighth school year the pupil must take the final examination. This examination is partly written and partly oral. The oral part is public. The student who passes this examination successfully receives a "certificate of maturity." He is then usually about 18 years of age.

The certificate of maturity from a Gymnasium entitles the pupil to entrance into any Hungarian university. The certificate of maturity from a Real school entitles a pupil to entrance into a Polytechnikum, or the mathematical or science department of a university.

THE UNIVERSITIES AND POLYTECHNIKUM, AND SECONDARY SCHOOL TEACHERS.

In Hungary there are five universities maintained by the State: The University of Budapest, with over 7,000 students and the chief center of classical and scientific study and research in the Kingdom; the University of Kolozsvár, with over 2,000 students; and the universities at Zágráb (Agram), Pressburg (Pozsony), and Debreczen, the last two of which were founded in 1912.[1] The Royal Josefs-Polytechnikum at Budapest has about 170 professors and about 1,800 students.

The secondary school education act of 1883 gives definite instructions concerning the training of secondary school professors. The candidate must meet the following requirements:

(*a*) He must have graduated from a Gymnasium or Real school. In the latter case he must be able to read and understand easy Latin, for example Cæsar's writings, Ovid's poetry, and Cicero's letters.

(*b*) He must have spent four years in a university or Polytechnikum devoted to the study of the special subjects he wishes to be qualified to teach. He must choose at least two subjects, and he is strongly recommended to take three. He must also show (1) proficiency in the Hungarian language, literature, history, and general Hungarian culture; (2) a thorough acquaintance with pedagogy, history, principles and methods of education; (3) a knowledge of the special methods of teaching his special subjects; and (4) that he has studied logic, psychology, and the history of philosophy.

(*c*) A year of practical teaching in a secondary school after the completion of the four-year university course, or five years at the university and at least a complete year of secondary school teaching accomplished during that time.

The candidates are examined by a special examination commission organized by the universities. The members of the commission are mostly professors from the universities and Polytechnikum, but some are also Privatdocenten or eminent secondary school professors.

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[1] Neither of these universities has a faculty of mathematics and science. The University of Pressburg was developed from the Royal Academy of Pressburg, and the University of Debreczen from a high school which had been in existence for over 300 years. *Cf.* Rept. of U. S. Commis. Educ., 1916, vol. 1, Washington, 1916, pp. 684–5.

According to an ordinance of 1888 the candidate must choose at least two special subjects which he wishes to teach, e. g., mathematics with physics or descriptive geometry. The ordinance recommends that the candidate should also make a special study of a third scientific subject [1] or else of philosophy.

The examination is threefold: I. The general examination at the end of the fourth semester; II. the examination on special subjects at the end of the eighth semester; III. the pedagogic examination at the end of the next year, which the candidate usually employs in professional practice.

Those who fail in an examination may come up again six months later. Those who fail a second time may not again present themselves for examination till a year later, during which period they must have attended lectures at a university or at the Polytechnikum.

I. The *General Examination* is composed of two parts, an oral and a written examination. The former is public. In the latter and in other written tests 10 hours are allowed. The candidate must write a theme in the Hungarian language on some subject of interest in Hungarian literature.

In the oral examination the mathematical candidate is examined in—

(1) Plane and spherical trigonometry; (2) analytic geometry; (3) analysis—complex numbers, infinite series, elements of the theory of equations and of differential and integral calculus; (4) descriptive geometry—(*a*) orthogonal parallel projection, axonometry, oblique parallel projection, central projection and collineation; (*b*) elements of the constructive theory of lines and surfaces; (*c*) shades and shadows; (*d*) perspective; (5)[2] physics—(*a*) experimental physics; (*b*) elements of analytic mechanics; (6) Hungarian language and literature; and (7) one modern language (German, French, English, or Italian), with the literature of the same.

At this examination the candidate must be provided with his certificate of birth, a medical certificate, his certificate of graduation from a secondary school, and a certificate to prove that he has studied the requisite time in a university.

It may be well to give indications of what knowledge is expected for the above examinations in analytic geometry and in analysis:

In analytic geometry: Points, lines, and complete discussion of conic sections; generation of conics by projective pencils, parabolas through four points; conics through five points, common properties of two conics, pencils of conics and circles, radical axis; line coordinates, trilinear coordinates, principle of duality, conics in line coordinates, generation of a conic by projective ranges, theorems of Pascal and Brianchon; point coordinates in space, lines and planes in space, coordinate transformation; facility in determining geometric loci.—In analysis: Thorough discussion of irrational and complex numbers, De Moivre's theorem, general theory of root extraction (binomial equations), properties of roots of unity; infinite series, conditional and unconditional convergence, series with complex members; convergency of power series, circle of convergence, continuity of power series; definition of elementary functions by power series; binomial, exponential, and logarithmic series; connection between exponential and trigonometric functions; Taylor's and Maclaurin's expansions; maxima and minima of one and of several variables; multiple integrals, surface, volume; fundamental theorem of algebra that every equation has a root; symmetric functions of the roots; cubic and biquadratic equations; approximation methods of Horner and Lagrange; elimination, methods of Sylvester and Bézout.

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[1] It is not uncommon for a candidate to offer as three subjects mathematics, physics, and descriptive geometry.

[2] If a candidate has not elected to specialize in both (4) and (5) he is examined in only one o. them.

II. After two more years of university study the candidate may present himself for examination in his *special subjects.* Five months before he presents himself he is given a theme in each of his subjects, upon which he has to write a dissertation. In this dissertation the candidate must show familiarity with the literature of the subject as well as originality and knowledge in its presentation. All authorities must be carefully indicated. These themes are passed upon by the professors of the examination commission. If a dissertation is regarded as "insufficient," another one has to be prepared.

In addition to these dissertations an oral examination is required. In this the candidate must show decided proficiency in each of his subjects. All aids, except a table of logarithms, are forbidden. In case of failure at the oral examination, another trial may be made in six months. The oral examination in *mathematics* is on: (1) The mathematics of the secondary schools; (2) certain parts of geometry, algebra, and analysis common for all candidates; (3) the following five subjects, one of which the candidate must know thoroughly, the others in a general way—(*a*) Modern geometry and the theory of algebraic forms; (*b*) number theory and higher algebra; (*c*) general theory of skew curves and surfaces; (*d*) general theory of analytic and elliptic functions; (*e*) advanced portions of integral calculus.

In connection with (1) the candidate must not only display such acquaintance with the subjects as is requisite for graduation, but also a deeper scientific insight into elementary mathematics and a thorough appreciation of rigorous analysis. Facility in geometric drawing is also required. As to (2) the general examination is supplemented by consideration of the following topics:

Elements of synthetic geometry, ranges and pencils, harmonic and anharmonic ratio, involution, projective properties of conics; point coordinates in space, different forms of the equation of a plane, tetrahedrons, classification of surfaces of the second degree, general properties, particular surfaces, pencils of quadrics; adjoint and compound determinants, volume of tetrahedron and other geometric applications, functional determinants; continued fractions and indeterminate equations; infinite products, Wallis's formula; total differential equations, existence of a solution, general and particular solutions, simplest differential equations of the first and second order, integrating factor, linear differential equations, variation of the constant, application of differential equations to geometric questions.

Under (3) the candidate is examined in the subjects indicated in the following synopses:

(*a*) Homogeneous coordinates in the plane and in space; conics and quadrics in these coordinates; symbolic notation; line coordinates in space; line geometry; projective properties of lines and surfaces; singularities; algebraic forms; binary and ternary forms; the most important invariants and covariants; general theory of quadratic forms; orthogonal substitutions.

(*b*) Elements of number theory; congruences; general theory of quadratic residues and quadratic forms; general theory of algebraic numbers; substitutions and groups; rational functions of roots of an equation; resolvents; cyclotomy; Abel's equations; conditions for the solution of algebraic equations; theorems of Sturm, Sylvester, and Hermite on the separation of roots of an equation; theory of elimination; chief proofs of the fundamental theorem of algebra (Gauss, Cauchy, etc.).

(*c*) Skew curves: Tangent and normal planes, first and second curvature, evolutes; curved surfaces; tangent and normal planes, lines on surfaces, surface elements, tangency of surfaces; theory of curvature, lines of curvature, orthogonal surfaces, confocal quadrics, Dupin's theorem, elliptic coordinates, conformal representation of surfaces; geodesic lines; partial differential equations of surfaces; theory of ruled surfaces.

(*d*) Functions of a complex variable: Single and multiple-valued functions, Riemann's surfaces, integration of functions of a complex variable, analytic expressions for single and multiple valued functions, Dirichlet's principle; algebraic functions, logarithms, trigonometric integrals; the three kinds of elliptic integrals and reduction of general elliptic integrals, the modulus of periodicity of integrals; periodic functions in general, fundamental properties of elliptic functions, theta functions, development into series; Abel's theorem, the problem of transformation.

(*e*) The more important definite integrals, multiple integrals, Fourier series and integrals, gamma functions, spherical harmonics; fundamental ideas of the calculus of variations, variation of functions, simple and multiple integrals, maxima and minima, second variation; simultaneous differential equations (general, complete, and singular solutions), partial differential equations of the first order; partial differential equations of the second order, integration of partial differential equations of mathematical physics by means of infinite series, methods of Monge and Ampère.

In *descriptive geometry* and *physics*, elaborate requirements are also made. To this oral examination the candidate must bring his certificate to show he has passed the general examination, and a certificate to show that he has studied two years further in the university or Polytechnikum.

III. A year after the special examination, the candidate may present himself for his *examination in pedagogy*. This consists of a philosophic or pedagogic dissertation, and an oral examination in history of philosophy, logic, psychology, pedagogy, history of pedagogy, and special methods for teaching mathematics. The examiners have constantly in mind the candidate's qualifications with regard to teaching all classes of the secondary schools. There is no such thing in Hungary as a teacher's being qualified to teach only in the lower classes of the State secondary schools. We have seen that this is not unusual in Austria.

In pursuing the courses leading to these examinations brilliant students may receive an annual stipend of 1,000 crowns ($200). The plan of study requires not less than 20 hours a week of lectures. In the first two years are:

History of Hungarian literature (2 semesters, 2 hours weekly); Hungarian language (1 s., 2 h.); Hungarian culture (1 s., 1 h.). In the third and fourth years are: Logic (1 s., 2 h.); psychology (1 s., 2 h.); theoretical pedagogy (1 s., 2 h.); history of philosophy (1 s., 2 h.); history of pedagogy (1 s., 2 h.).

Lectures on subjects of the group *mathematics and physics* are distributed as follows (all subjects run through the year):

First year: Geometry and analysis (9–12 hours); algebra and number theory (3 hours); experimental physics (7 hours).

Second year: Analysis, continued (3 hours); geometry, continued (2 hours); algebra or number theory (3 hours); exercises with reference to the program of the secondary schools (2 hours); mechanics (6 hours); numerical exercises in physics (2 hours).

Third year: Special lectures in mathematics (5 hours); mathematical exercises (2 hours); scientific treatment of the subjects in the secondary schools (2 hours); theoretical physics (4 hours); exercises in experimental physics (5 hours).

Fourth year: Special lectures in mathematics (5 hours); mathematical exercises (2 hours); scientific treatment of the subjects in the secondary schools (2 hours); theoretic physics (4 hours); chemistry (2 hours).

For the group *mathematics and descriptive geometry,* the schedule is as follows:

First year: Geometry and analysis (9–12 hours); algebra and number theory (3 hours); descriptive geometry (5–6 hours); constructive drawing (7 hours).

Second year: Continuation of analysis (3 hours); continuation of geometry (2 hours); algebra and number theory (3 hours); exercises with reference to the program of the secondary schools (2 hours); projective geometry (2 hours); special lectures on descriptive geometry (2 hours); review and questions of descriptive geometry (3 hours).

Third year: Special lectures in mathematics (5 hours); mathematical exercises (2 hours); scientific treatment of secondary school mathematics (2 hours); special lectures and exercises in descriptive geometry (4 hours).

Fourth year: Special lectures in mathematics (5 hours); scientific treatment of secondary school mathematics (2 hours); mathematical exercises (2 hours); special lectures and exercises in descriptive geometry (4 hours).

In Budapest the student may attend such courses in both the university and the Polytechnikum.

The Baron Eötvös College in Budapest is an important institution—the object of which is to give deserving students of the Budapest University who intend to enter the teaching profession an opportunity for holding social intercourse with their fellows and for acquiring the theoretical and practical knowledge necessary to qualify them for their work. The college is directly subordinate to the minister of public instruction, who delegates his authority to the curator. For expert guidance of the resident students four tutors (chosen by the curator from among the teachers in the service of the State) are appointed by the minister (for periods of three years in rotation) for special duties. They are present in the college during the hours devoted to private study to give individual or combined instruction to the candidates, and, as occasion arises, to hold special courses of lectures.

We have yet to consider the institutions where our future secondary school professor, who has completed his four years in the university, receives a year of professional training.

Under the direct control of the minister of education is a State Training College (founded in 1895) for Secondary Teachers. It is established at Budapest, and its aim is to train university students for the profession of teaching. The students all live together in the training college, and continue their university studies simultaneously with their pedagogic training. At the head of the college is a curator, and under him are four professors who are appointed by the minister. It is the duty of these professors to teach the students the principles underlying education, and to show them how they can be applied. The students teach in a Gymnasium connected with the training college for that purpose. The methods adopted are Herbartian as worked out by Ziller and Stoy. At the end of each school year the curator and professors formally confer together in regard to the students' progress, and weed out the unsatisfactory ones. Students may not remain in the college longer than four years.

There is also the famous Pedagogic Seminar at Budapest, founded in 1872 by Dr. Kármán.[1] This institution was modeled on Ziller's "Seminar" at Leipzig. It has three distinct aims: (1) To be a gymnasium; (2) to be a practice school for secondary teachers; (3) to be an institution for promoting special methods of teaching in Hungarian secondary schools.

The students in the Budapest Pedagogic Seminar are young men who have spent eight years in a secondary school and four years in a university and have passed the general and special examinations given by the examination commission.

They make a thorough study of the theory of special secondary school teaching in connection with practical experience of the same. Their philosophic and theoretic studies are already completed. The staff consists of leading professors of special subjects, a professor of pedagogy, and a director.

After each candidate announces the special subject he wishes to teach, he is placed under the direction of the professor of that subject. At first he is not himself permitted to teach, but he must attend all the lessons the directing professor gives to the various classes; he must then work out series of lessons under the direction of the professor; and after about three months he may begin to teach. The professor is always present at his lessons to offer him advice and criticism.

Every week there is a *Praktikum* or criticism lesson. In the early part of the year these lessons are given by the professors, with the whole Seminar present. In the latter part of the year the candidates give the lessons, and conferences are held two days after each lesson, in which all points raised by the Praktika are fully discussed. Twice a week a *Theoretikum* is held in which general principles and special methods of secondary school teaching are discussed.

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[1] For a description of this Seminar the following articles on "Das Pädogogische Universitäts-Seminar in Budapest" in *Pädagogische Studien* (Neue Folge herausgegeben von W. Rein at Dresden) may be consulted in Jahrgang 8 (1887), pp. 219-222, by E. Leonhardt; in Jahrgang 9 (1888), pp. 99-103. It will also be of interest to turn to M. KÁRMÁN *Beispiel eines rationallen Lehrplans für Gymnasien*, Halle a S., 1890.

Teachers of secondary schools attain to full service after three years' probationary service. At this stage they receive an annual salary of 2,000 crowns ($400) in the capital, and 1,600 crowns ($320) in the provinces. The teachers under full appointment are divided into two classes. Salaries in the lower class begin at 2,600 crowns and rise by periodical increase, to 3,200 crowns; in the higher classes the salaries increase by successive additions, from 3,600 to 4,400 crowns. Directors receive from 4,800 to 6,000 crowns.

After 10 years' service, according to the regulations of 1894, a teacher is entitled to a pension of 40 per cent of his salary, and for each year of further service the pension increases by 3 per cent, so that at the end of 30 years' service the teacher may retire on full salary.

Teachers contribute to the pension fund one-third of the excess of a year's salary above 690 crowns, and one-third of every increase in salary. These sums are paid only once.

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X. ITALY.

Italy is about 110,600 square miles in extent, and its population of upward of 36,000,000 is in general perfectly homogeneous in language, except for about 250,000 people of French, Teutonic, Slavonic, Albanian, Greek, and Spanish origin.

The educational system of the country is under the direction of a minister, who is a member of the cabinet and either a deputy or a senator. He is assisted and in some respects controlled by the *consiglio superiore* or higher council which, in accord with legislation of 1909, has 36 members. These members consist of 6 senators elected by the Senate, 6 deputies (not university professors) elected by the Chamber of Deputies, 12 members nominated by the minister, and 12 designated by the ordinary and extraordinary university professors. The consiglio, on request of the minister, prepares and examines all bills and general provisions relating to the organization of schools, appointment of professors, etc. The power of control on the part of the consiglio is illustrated by the fact that the minister can neither dismiss nor suspend a professor without its consent.

Three departments of the ministry of public instruction are concerned, respectively, with elementary and normal education, secondary education, and higher education.

SECONDARY SCHOOLS.

The secondary-school training of Italy is based upon four years' preparation in the elementary schools (pupil's age 6 to 10 years). Apart from certain normal schools there are two broad types of secondary schools: (1) Classical schools and modern schools with Latin; (2) modern schools without Latin, and technical schools. Of the first type there is the *ginnasio,* with a five years' course leading up to the *liceo,* whose three years' course prepares for entry into the universities. The second type includes the *scuola tecnica* and *scuola complementare,* each with a three years' course. They are preparatory for such schools as the *istituto tecnico,* with a four years' course,[1] and the *istituto nautico,* with a course of three years.

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[1] As an exception the course for the industrial section of the istituto di Bergomo lasts five years. Concerning mathematical instruction in technical schools and institutes, see *G. Scorza, L'insegnamento della matematica nelle scuole e negli istituti tecnici.* (Commissione internazionale l'insegnamento matematico.) Roma, 1911. 34 pp.

In 1912–13 the relative numbers of these schools for boys and girls were as follows:

	Government.	Private.
Normal schools	144	124
Ginnasî	291	262
Licei	162	77
Technical schools	344	207
Technical institutes	79	32
Mercantile marine institutes	20	0

No student is admitted to a secondary school unless he has passed an examination called *maturità*.

The course of study in the classical ginnasio includes the Italian language and literature, Latin, Greek, French, mathematics, and a little drawing and natural history. In the corresponding liceo, philosophy, physics, and chemistry are taught in addition to all the subjects (except French) of the ginnasio. In the "modern" ginnasî and licei, established by an act of 1911, Greek is no longer taught; instruction in Italian, Latin, French, German, or English, geography and history; mathematics, natural history, drawing, and physical culture is given at these ginnasî. Besides these the course at the corresponding licei includes, in addition, political economy, philosophy, civics, physics, chemistry, astronomy, and physical geography. In cities having a ginnasio and a liceo, the two schools are combined in a *liceo-ginnasio*. The "modern" schools with Latin are being established in those cities which have more than one liceo-ginnasio. The *licenza ginnasiale*, or diploma, of a ginnasio represents the standard of training for minor posts in the civil service and for the licei. The diploma *licenza liceale*, awarded after the satisfactory completion of the eight-year period of secondary education, admits to the universities.

At this time the student who has taken the possible mathematical courses of the liceo has been taught—

> In *algebra:* Equations of the first and second degree, progressions, theory of indices, theory of logarithms, binomial theorem, irrational numbers, prime numbers and divisibility, indeterminate equations of the first degree. In *geometry:* Relations of positions, equality of solids; proportion and similitude in plane geometry; measurement; theory and application to plane geometry; practical rules for the measure of curved surfaces and of solids; equivalence and similitude of solids; theory of the measure of curved surfaces and of solids; applications of algebra to geometry. In *trigonometry:* Through the solution of plane and spherical triangles.

This work is covered by four hours a week of work in the first year, three hours in the second, and two in the third.

From these indications we observe that in the liceo-ginnasio mathematics does not occupy the central position, as in corresponding schools of other countries such as France.

In the physico-mathematical section of an istituto tecnico six hours a week are devoted to arithmetic, algebra, and geometry in the first year; five hours to the same subjects in the second year; and five hours in the third year to algebra, geometry, plane and spherical trigonometry, and the elements of descriptive geometry. All of the mathematical subjects of the liceo-ginnasio are here treated much more fully. The following topics are sometimes introduced: Geometry of the triangle, geometrography, derivatives and their applications to maxima and minima, equations of the third and fourth degree, probabilities, determinants, history of elementary mathematics.

Thorough grounding in geometry is characteristic of Italian secondary schools. It is only necessary to recall in this connection the works of Sannia and D'Ovidio, Faifofer, Lazzeri and Bassani, and de Paolis.

Having thus gathered impressions as to subjects in which a teacher of mathematics in leading secondary schools has to give instruction, let us next consider those schools where the mathematical teachers are trained.

THE UNIVERSITIES AND TRAINING OF SECONDARY SCHOOL TEACHERS.

The term "university" is applied in Italy only to those schools of the highest grade in which students are instructed in special branches for the professions of their choice. There are in Italy 21 universities,[1] 17 bearing the description "royal" and receiving State subsidies and 4 independent of Government control. The free universities are at Perugia, Ferrara, Urbino, and Camerino. The oldest university was founded at Bologna about 1200 and the youngest at Palermo in the early nineteenth century. The other universities are at Padua, Macerata, Naples, Genoa, Pavia, Rome, Pisa, Siena, Turin, Catania, Parma, Messina, Sassari, Cagliari, and Modena. The largest university is at Naples, where there were more than 4,000 students in 1913–14; in point of size the university at Rome, with over 3,000 students, ranks next.

Repeated efforts have been made to reduce the number of royal universities, which exceed both the needs and the resources of the nation. As a consequence a few vigorous universities are found in the same class with a number of struggling institutions that are quite unable to maintain standards and prestige. The condition has been the subject of much discussion in the legislature, but so far no modification has resulted. Meanwhile complaints have arisen that the standards of secondary education are depressed as a consequence of the competition for students on the part of the universities.[2]

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[1] There are about a score of schools known as "superior institutes," which have the scholastic program of universities. Though private they are more or less under the control of the Government. Probably the oldest now in existence is that founded at Florence in the fourteenth century. An account of mathematics taught in the five-year course of the Reale Istituto Tecnico Superiore at Milan is given by V. Snyder in "Mathematics at an Italian Technical School," *Bulletin of the American Mathematical Society*, December, 1916, vol. 23, pp. 149–151.

[2] Rep. Commis. of Educ., 1913–14. Washington, 1915, vol. 1, pp. 757–758.

The faculty of sciences in the university has a section of mathematics in which the object is twofold: (1) To give to future engineers the preparation which will fit them for the Scuole di Applicazione (schools of applications); (2) to prepare candidates for the degree of doctor in mathematics.[1] This degree is a prerequisite for teachers of mathematics in secondary schools.

Preparation for the degree requires four years of study, the first two leading to the licenza. The courses followed during this period are in physics, inorganic and organic chemistry, algebraic analysis, infinitesimal analysis, analytic geometry, projective geometry, descriptive geometry, and drawing.

The *licenziati dell'universita* then attend lectures at a school for preparation of secondary school teachers (scuola di magistero) and follow courses at the university in five or six of the following subjects: Higher analysis, higher geometry, higher mechanics, theoretical geodesy, astronomy, mathematical physics. The scuole di magistero are connected with the faculties of sciences, and in them one or two professors give lectures on methods of teaching, etc. The diploma di magistero obtained from these scuole is a distinct advantage to its holder when he is seeking a position in secondary teaching.

At the end of a year the licenziato generally offers himself for examination in at least three of his five courses; his second year is largely occupied with his dissertation and the preparation of his minor theses. The final examination, which is oral, is held before a commission of 11, consisting of 7 professors of the faculty and 4 privati docenti. If the examiners award the candidate a mark of not less than 60 per cent, he is proclaimed *dottore in matematiche pure* by the dean of the faculty.

It very often happens that candidates add to the required four years of study a fifth, for the preparation of the dissertation and for attendance at special courses such as those of the R. Scuola Normale Superiore of Pisa and of the "Istituto consorziale" of Pavia, or of the recently established mathematical seminaries of the faculties of science at Rome and Naples.

While the annual number of mathematical dottori in Italian universities has not appreciably increased in the last 30 years, the number of secondary schools has greatly augmented, and the problem of procuring properly qualified teachers has been a very difficult one to deal with. Furthermore, the problem is not altogether one of numbers. It is strongly felt by many that while the larger universities furnish an admirable scientific training, far too little attention has been paid to the professional and practical training.

The first appointment of a teacher in a secondary school is for three years, after which the appointment may be made permanent if the inspector's report is favorable;

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[1] A doctor's degree is required for admission not only to the professions (physician, lawyer, teacher in secondary school, etc.), but also to the highest grade clerkships in the Government service in all branches.

if not, the appointment is extended for another year, when the teacher is definitely appointed or dismissed. During this probationary period the teacher (*professore*) is called extraordinary (*straordinario*); after the definite appointment, ordinary (*ordinario*)[1] As a rule a teacher is appointed for a single study or for two related subjects.

Teachers in the first three classes of the ginnasio receive as salary about $347 (1,800 lire)[2] a year (if extraordinary) and from $386 to $926 (2,000 to 4,800 lire) if ordinary. In the case of the teachers in the licei and in the fourth and fifth classes of the ginnasî these salaries are increased to $414 if extraordinary and $482 to $1,042 (2,500 to 5,400 lire) if ordinary.[3]

All ordinary teachers receive four quinquennial increases in salary of 500 lire each. An increase of one-tenth of this salary is made at the end of two six-year periods. "In this way they pass from the minimum to the maximum salaries as given above. Two of the four fixed increases, but not two consecutive ones, may be anticipated one year in the case of exceptionally able teachers."

Headmasters in schools are appointed from teachers who have taught for thirteen years, and from a list compiled by the consiglio superiore—

in accordance with results of inspections. They are appointed for a first period of five years, during which they teach and receive extra compensation varying from 750 to 1,000 lire a year. After the probationary period they are permanently appointed and receive salaries not higher than 5,750 lire for such schools as ginnasî and 6,500 lire for schools of the licei standard. Schools equivalent to Government schools must pay the same salaries.

The teacher is entitled to a pension proportional to his salary and the length of his service. A pension equal to the full salary at the time of retirement is due to the teacher who has served continuously for 25 years or more. In case of his death two-thirds of the pension awarded to the husband or father is paid to the widow or to the children if orphans.

NORMAL SCHOOLS.

The normal schools form a third type of school in secondary education. All that has been stated above with reference to the appointment, salaries, and pensions of licei teachers applies to teachers in the normal schools. Their courses are designed to qualify teachers for the primary schools.

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[1] In certain cases when a teacher would have only a few hours a week a temporary appointment is made. Such appointments are also made if a regular appointee can not be found for the place, and in schools with a large number of pupils when it is necessary to divide classes and the regular teacher can not take charge of all.

[2] The lira equals 19.3 cents.

[3] A comparison of these salaries with those of university professors may be of interest. In accordance with a recent law, the salary of the ordinary professor of State universities is fixed at 7,000 lire minimum; that of the extraordinary professor at 4,500 lire. The salary of the ordinary professor may be increased until a maximum of 10,000 lire is reached through quinquennial increases of 750 lire each. The salary of the extraordinary or special professor has a one-tenth quinquennial increase, but must never exceed the initial salary of an ordinary professor.

A licenziato of a scuola tecnica is prepared to enter a scuola normale with its course of three years. To students with the licenza ginnasiale many ginnasî offer a two-year corso magistrale.

The plan of studies for a scuola normale includes pedagogy, ethics, Italian, history, geography, the elements of mathematics,[1] accounting, physics, chemistry, natural history, and hygiene, drawing, penmanship, singing, agriculture, gymnastics, practice in elementary schools, and manual training.

In England and the United States it is important that a teacher should be able to maintain discipline in the classroom. But in Italy matters are ordered differently.

> Youngsters in their early teens aim to shape municipal policies; they get up demonstrations and indignation meetings, and go on strikes when their instructors fail to comport themselves to their liking.[2]

In the university—

> there are unannounced holidays. At periods of political excitement the students have a patriotic custom of marching on the professors for speeches. Should the doors be locked they will applaud enthusiastically thereon with hands and feet. As there is no discipline to deal with these cases, and it is not etiquette to introduce the police, the authorities frequently adopt the prudent course of closing the university until word arrives that the students are ready to return to ordinary academic ways.

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[1] Two hours a week: Arithmetic, plane and solid geometry, accounting.

[2] Rep. of U. S. Commis. Educ., 1906, vol. 1, Washington, 1907, p. 82.

XI. JAPAN.

The area of Japan proper is less than 150,000 square miles, and its total population is about 56,000,000.

One of the most prominent features of its educational system is the almost absolute centralization of authority. Educational affairs are administered by a department of education, at the head of which is the minister of education, who is a member of the imperial cabinet and is directly or indirectly in charge of everything pertaining to education. He is assisted by a vice minister, several directors of bureaus, and a number of councilors and secretaries. The department of education was first definitely established in 1871, and in the following year there was issued a code which stipulated that the whole country should be divided into 8 *large educational* districts, each with a university. Each of these districts was to be subdivided into 32 *intermediate educational* districts, each with a secondary school, every one of which was in turn to be further subdivided into 210 *small educational* districts, each with an elementary school. This plan, which bore striking resemblance to the French scheme, was found too ambitious to carry out in its entirety. Elementary schools were indeed established largely as planned. The standard for secondary schools is still unsettled although, since the promulgation of the code, reforms in secondary education have been of a sweeping character. As recently as April, 1912, certain new reforms went into effect. Of these I will take no account in what follows. As to the universities, not more than one of the four in existence is 20 years old, so that this branch of the educational system falls far short of the ideal of the code.

Immediately above the elementary course of six years is the *middle school* course of five years, "socially obligatory" for membership in the educated class. A one-year supplementary course is sometimes offered. Pupils begin in the middle school at the age of 12 years. Next in order to the middle schools comes the *higher middle school*, whose course extends over three years. Much of the discussion as to secondary education is centered upon the question whether this school, intermediate between the middle school and the university, is to be affiliated with the former or with the latter. On the whole the tendency seems to be in the direction of giving greater prominence to the higher general education. And the aim of the higher middle school is preparation for the different faculties of the university. There are four imperial universities at present, namely, those at Tokyo, at Kyoto (the ancient capital), at Kiushiu (the southern island), and at Tōhoku ("northeastern"). The normal age of a student prepared to enter a university is about 20 or 21. In the higher middle school he has covered the work of about the first two years in an American college of the better class.

Baron Kikuchi writes:

> In all cases graduation from one school is a qualification for entrance into the next higher stage, but in recent years the demand for higher education has increased at such a rate that, notwithstanding the very great and rapid expansion of educational resources, a competitive examination for admission has to be held at almost every stage, the number of candidates for admission being from twice or three times to even in some cases as large as 10 times the number of those that can be admitted.

This is particularly true of the higher middle schools, of which there are only eight. The students who arrive at the university are thus likely to be the élite of the youthful intellectuals.

The only branch of mathematics taught in the *elementary schools* is arithmetic. There is much practice in *soroban* calculations.[1]

In the *middle schools:* Arithmetic (conclusion); algebra through such subjects as ratio and proportion, progressions, permutations and combinations, binominal theorem with positive index; logarithms; elements of plane and solid synthetic geometry, as in Baron Kikuchi's book which is based upon the syllabi of the Association for the Improvement of Geometrical Teaching; plane trigonometry, through the solution of triangles.

The competitive examination for entrance into the higher middle schools is excessively severe and of a nature that is far from winning general approval. The examinees are picked boys from over 300 middle schools scattered all over the country. Among them are those who have failed one, two, three, or even more times. The percentage of those who succeed on first trial is small.

In the *higher middle schools* there are three sections; the first is for those who wish to enter the faculty of law or literature in the university; the second for those who wish to enter the faculty of science, technology, or agriculture, or a certain part of the faculty of medicine; the subjects in the third section are religion, the Japanese language, foreign languages (German and either English or French), Latin, mathematics, physics, chemistry, zoology, botany, and gymnastics. The chief mathematical training is given in the second section. The subjects of study include trigonometry, algebra, analytic geometry, and calculus.

In *trigonometry*, Todhunter's "Plane Trigonometry for the use of Colleges and Schools" is used as a textbook.

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[1] The soroban is a variety of abacus.

In *algebra*, besides R. Fujisawa's "Sequel to Elementary Algebra" (written in Japanese), Todhunter's "Algebra for the Use of Schools and Colleges" and C. Smith's "Treatise on Algebra" are used as texts. Some of the topics discussed are: Inequalities; theory of determinants; theory of probability; theory of numbers; continued fractions; indeterminate equations; convergency and divergency of infinite series; symmetric functions of roots; cubic and biquadratic equations; methods of elimination.

In *analytic geometry*, besides Kikuchi's "Plane and Solid Analytic Geometry," Puckle's "Conic Sections and Algebraic Geometry" and N. S. Aldis's "Treatise on Solid Geometry" are used as texts.

In *differential and integral calculus* the textbooks used are those of Todhunter and Williamson. The chief books of reference in current use, though not necessarily confined to higher middle schools, are the calculus treatises by Kiepert, Czuber, J. A. Serret, Byerly, Lamb, Greenhill, as well as Appell's "Élément d'Analyse Mathématique" and J. W. Mellor's "Higher Mathematics for Students of Chemistry and Physics."

THE UNIVERSITIES.

The higher middle schools are preparatory institutions for the imperial universities, where the greater part of the students enter the college of engineering. The first article of the imperial ordinance for the founding of imperial universities reads: "Imperial universities shall have for their objects the teaching of such arts and sciences as are required for the purpose of the State, and the prosecution of original research in such arts and sciences." The second article of the same ordinance runs: "Each imperial university shall consist of a university hall and faculties, the university hall being established for the purpose of original research, and the faculties for instruction theoretical and practical." At present only three of the universities have faculties of science. The length of a course is either three or four years. At the end of every year there is a thorough examination. A graduate is entitled to call himself *gakushi* or "graduate of a university faculty."

Owing to the insufficiency of schools, boys are often required to pass competitive examinations in going from an elementary to a middle school as well as from a middle to a higher middle school. Moreover, as is only natural, some of them may not be able to finish a school course in the prescribed number of years. Thus it happens, not infrequently, that a student reaches the age of 30 or thereabout by the time he has finished his university course.

The newer universities are modeled upon the University of Tokyo, which is far more completely organized. At this university the following mathematical courses are offered in the faculty of science:

FIRST YEAR.

Differential and integral calculus, four hours a week through the three terms of the year. This includes discussion of: Volume and area of surfaces; moments of inertia; integration of ordinary differential equations of the first and higher orders and their applications; linear and simultaneous differential equations; calculus of variations.

Solid analytical geometry, four hours for one term. Lines; planes; surfaces of the second degree; elements of the general theory of surfaces.

Projective geometry, two hours a week in second and third terms. Synthetic and analytic discussion of projective forms of the first order; curves of the second degree and second class.

Select chapters in elementary mathematics, three hours a week in second and third terms. Elementary algebra; domain of rationality and divisibility of integers, of rational integral functions of one variable and of many variables; algebraic solutions of the general equations of the first, the second, the third, and the fourth degrees. Sturm's theorem, etc.

Astronomy and least squares, three hours a week through the year. Some of the topics are: Spherical trigonometry; fixed stars; sun; calendar; planets; moon; eclipses; rotation of planets; precession and nutation; theory of probabilities; law of errors; method of least squares.

General physics, three hours a week through the year.

SECOND YEAR.

General theory of functions and theory of elliptic functions, three hours a week through the year.

Differential and integral calculus and differential equations, two hours a week through the year. Topics here discussed are: Fourier's series and integrals; Legendre's and Bessel's functions and hypergeometric series; total and partial differential equations, etc.

Theory of numbers and algebra, five hours a week through the year.

Higher geometry, three hours a week through the year. Differential, noneuclidean, or descriptive.

General dynamics, three hours a week through the year.

THIRD YEAR.

The titles of the courses in this year are practically the same as those in the second; the student is lead on to deal with advanced topics.

Other courses in astronomy and theoretical physics are also given, but further details are not germane to our subject.

PREPARATION OF MIDDLE SCHOOL TEACHERS.

To become a regular teacher in a middle school it is necessary to have a license granted by the minister of education. This is given (1) without examination to graduates of Government schools and institutes especially established for training teachers and to others specified later, and (2) after examinations to still others. The examinations are conducted at least once a year by an examining board appointed from among the professors of the imperial universities, of higher normal schools, of higher technical schools, and of similar institutions. The examinations for teachers' licenses in mathematics are of four grades: The first consisting of arithmetic, algebra, and geometry;

the second of trigonometry; the third of analytic geometry; and the fourth of differential and integral calculus.[1] The examinations are held separately for each grade, and at the same time there is a test as to sufficient knowledge of the outlines of pedagogy and of pedagogic methods. Teachers of mathematics in the middle schools are not regarded as fully equipped for their work unless they have been successful in passing the examination for all four grades. The majority, however, simply have licenses in the first grade. Graduates of the regular and special courses in mathematics in the higher normal schools, as well as certain others, are regarded as having successfully passed the examinations in all four grades and are entitled to licenses in them all.

HIGHER NORMAL SCHOOLS.

The schools specially established for the training of teachers consist of higher normal schools, of which there are two at present, one at Tokyo and the other at Hiroshima. The single temporary institute engaged in training teachers in mathematics is located at Sendai.

Each of the higher normal schools has a four years' course, one year preparatory, and three years' regular course. The preparatory course is common to all students. The regular course, in which only special subjects are taught, is divided into five departments, that having special interest for us being called the "Department of mathematics, physics, and chemistry." This in its turn is divided into two minor divisions, one for students of mathematics and physics, and the other for students of physics and chemistry.

Students entering the preparatory course of the higher normal schools are mostly graduates of middle schools or of normal schools, or are students recognized to have scholarship equal to that of the graduates of either of these schools. In the Tokyo Higher Normal School, out of applicants from all parts of the Empire only those are admitted who have the highest grade in the entrance examination. At present, in the department of mathematics, physics, and chemistry, about 50 are admitted as preparatory students out of three or four hundred applicants. In Hiroshima the method of selection is different, but the number in this department is less than at Tokyo.

In both schools students enter at the average age of 21; so that the average age of graduates is 25.

The students in the preparatory course of the Tokyo Higher Normal School are required to take 30 hours' classroom work a week, of which 4 hours are devoted to mathematics—making a total of 160 hours for the year. Of these, 20 to 25 hours are given to arithmetic, 40 to 45 hours to algebra, some 50 hours to geometry, and about

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[1] Copies of these examination papers for 1911 are given in Appendix F.

30 hours to plane trigonometry. The work is based upon that of the middle school rather than that of the normal school, which is fuller and more advanced. Nearly the same instruction is given in the preparatory course at Hiroshima.

In the Tokyo Higher Normal School the first-year students of the department of mathematics, physics, and chemistry are required to take a total of 26 hours of classroom work a week throughout the year, in addition to hours for laboratory experiments in physics and chemistry. Of the 26 hours, 2 are devoted to algebra, 2 to trigonometry, and 2 to geometry. The topics taken up are:

In algebra—Inequalities; theory of quadratic equations; maxima and minima; equations of higher degree; simultaneous quadratics; ratio, proportion, and variation; series; progressions; permutations and combinations; binomial and multinomial theorems; limiting values; exponential theorem; logarithmic series; determinants.

In geometry—Foundations of geometry; definitions and axioms; noneuclidean geometry; demonstrations of theorems; maxima and minima; geometric loci; problems of geometric constructions; geometry of the triangle; modern geometry; history of elementary geometry.

In trigonometry—Identities; relations between the sides and angles of a triangle and a quadrilateral; measurements of heights and distances; inverse trigonometric functions; trigonometric equations; trigonometric inequalities; maxima and minima; trigonometric solution of algebraic equations; use of tables of trigonometric functions, and tables of logarithms; construction of these tables; rules of proportional parts.

The courses in algebra and trigonometry are required for all students in this department, but students specializing in physics and chemistry may substitute for the course in geometry described above a course in cartesian geometry.

The second and third year students are divided into two sections, the one consisting of those who take mathematics and physics as their specialties and the other of those who take physics and chemistry. The students of both sections have 23 hours of classroom work per week in all subjects. To students of the first section experiments in physics and exercises in mathematics are assigned outside of these hours. In the second year, 6 of the 23 hours are devoted to higher algebra, modern geometry, and analytic geometry. In addition 4 hours a week are allotted to mathematical exercises or to lectures on mathematical subjects.

Higher algebra, two hours a week. Some of the subjects treated are: Infinite products; continued fractions; indeterminate equations; properties of rational integral functions; algebraic equations; symmetric functions of roots of equations and their applications; solutions of numerical equations; elementary theory of numbers; divisibility; congruences.

Analytic geometry, four hours. Some of the topics are: Straight lines; circles; parabolas; ellipses; hyperbolas; general equation of the second degree; systems of conics; homothetic and similar conics; coordinates in space; lines and planes; surfaces of the second degree.

Of the four hours for mathematical exercises two are devoted to supplementing the above-mentioned course of algebra, with assigned exercises in algebra. The remaining two hours are devoted to lectures, some subjects of which are as follows:

Complex numbers; De Moivre's Theorem; roots of a number; binomial equations; relations of surds; trigonometric factorizations; powers of a complex number the exponent of which is a complex number; logarithm of a complex number; expansions in trigonometric series; demonstrations of theorems and solutions of problems in Euclidean space; problems impossible of geometric construction—trisection of an angle, duplication of the cube, quadrature of the circle; transcendence of e and π; constructible regular polygons.

In the third year the students are engaged in practical teaching during the whole of the last term. During the first two terms 23 hours a week are devoted to lectures, of which 10 hours are in mathematics, as follows:

Differential and integral calculus, six hours. Some of the topics are: Higher differential coefficients and differentials; curvature of plane curves; evolutes and involutes; functions of two variables, partial differentials; total differentials; surfaces and osculating paraboloids; indicatrix; principal curvatures; curves in space; tangent, normal, binomial, principal normal, rectifying line and cone, curvatures and spherical curvatures; Gregory's series, evaluation of π; existence theorem of integral calculus; differentiation and integration under the integral sign; quadrature of areas; center of gravity; moments of inertia; Lagrange's interpolation formulæ; mechanical quadrature; nonequidistant ordinates of Gauss; Eulerian integrals, Stirling's formulæ; linear differential equations with constant coefficients; characteristic equations; particular and general solutions; differential equations of the first order, singular solutions; existence proof according to Lipschitz; uniqueness of solutions; linear equations of the second order; Fourier's functions, trigonometric series; equations of potential functions, of small vibrations, and of heat diffusion.

Two hours a week are given to discussion of additional work in *Analytic geometry:* General theory of curves; construction of curves in rectangular and polar coordinates; singular points; limaçon, epicycloid; spiral of Archimedes; logarithmic spiral; strophoid; etc.

The remaining two hours are allotted to problems in calculus and dynamics: Velocities and accelerations; straight motions; circular motions; parabolic motions; elliptic motions; constrained motions; elements of rigid dynamics and hydrodynamics.

The mathematical requirements in the Hiroshima Higher Normal School are very similar to those in the Tokyo school. The aim in teaching mathematics in both of these schools is to develop in the student a well-disciplined logical faculty, to lead him to acquire a practical knowledge, and to heighten his æsthetic sense of scientific beauty.

Among the graduates of the higher normal schools there are a very limited number who, instead of immediately engaging in teaching, take the graduate course. This course, still looking toward the teaching of mathematics in middle schools, prescribes theories of mathematics considerably in advance of those discussed in the regular course. The aim is to strengthen the student's grasp on the fundamentals of mathematics prescribed by the curriculum of middle schools. An account of the condition of mathematical instruction throughout the world is generally given. The theory of numbers, higher algebra, theory of curves and surfaces, hydrodynamics, etc., are sometimes offered. The time allotted is from 6 to 12 hours per week.

Very few of the graduates of the higher normal schools enter the imperial universities for further study.

The mathematical requirements in the Sendai Institute are almost identical with those in the higher normal schools.

Besides the three institutions mentioned above whose graduates are given teacher's licenses, there is a private school in Tokyo, called the Tokyo Butsuri Gakko (Physics School at Tokyo), most of whose graduates go out to teach in the middle schools. The graduates of this school, however, are required, in order to obtain teachers' licenses, to pass the examination conducted every year by the educational department. Similar conditions obtain in connection with the recently established Waseda University, a private institution which has established a higher normal course containing a branch for training teachers of mathematics.

Teachers' licenses in mathematics are also given without examination to the following:

1. Graduates of the schools named below or of their special courses, having the approval of the minister of education: (*a*) Mathematical course, astronomical course, theoretical physics course, experimental physics course of the Science College, Tokyo Imperial University; (*b*) mathematical course, physics course, of the Science and Engineering College, Kyoto Imperial University; (*c*) mathematical course, physics course of the Science College, Tōhoku Imperial University.
2. Graduates of a normal or a middle school who have studied three or more years at any of the schools recognized by the minister of education as qualifying students for teachers' positions.
3. Graduates of a normal or a middle school who have studied abroad at a university or at a school of similar grade and have degrees or diplomas from such schools.
4. Graduates of schools abroad similar in grade to a normal or middle school in Japan, who have studied at a university or at a school of similar grade abroad and have degrees or diplomas from such schools.
5. Persons who have teachers' licenses for schools equal in grade to, or higher than, the one in which they wish to teach.

Teachers with a license have the title *Kyoyu;* otherwise, however learned or proficient they may be, they are known as *Kyoyu Kokoroe* (temporary or substitute Kyoyu), assistant Kyoyu, or assistant

Kyoyu Kokoroe. These licenses are granted either to those who pass the examination or to those who are considered able to pass it. The supply of teachers in mathematics is entirely inadequate to meet the demand. It has also been felt by some that the lack of general education on the part of the teachers is a serious defect in the training, however admirable may be the extensive special knowledge which the teacher has in the subject in which he instructs.

I find no information in the reports with reference to the preparation of teachers for the higher middle schools of Japan. Prof. Hayashi, of the Tōhoku Imperial University, has, however, very courteously supplied me with the following facts: In the eight higher middle schools during 1915–16 there were 256 professors, and 27 assistant professors, and about 70 lecturers. Among these instructors were 27 mathematical teachers, almost all of whom were *gakushi*. But some of them were not gakushi, and only one was a hakushi (doctor) as well as a gakushi. There are no special regulations with regard to the training of teachers of mathematics for higher middle schools.

Although competition is keen for the various teaching positions, there is little monetary inducement to take up teaching as a profession. As Baron Kikuchi writes:

> The salaries of teachers, from the university professors to primary-school teachers, are very inadequate; this, no doubt, is one of the reasons why the supply of teachers is not sufficient to meet the demand. More than half of the 140,000 primary-school teachers have salaries ranging between 15 and 24 yen ($7.50 to $12) a month, which even allowing for the low rate of living in Japan is very inadequate; the highest salary for a university professor is about 4,000 yen ($2,000). All teachers in Government or public schools and colleges are entitled to a pension equal to one-fourth the amount of their salary at the time of retirement if they retire after 15 years of service, and to an additional one two-hundred-and-fortieth of the amount of their salary for every year exceeding 15.[1]

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R. FUJISAWA. *Summary Report on the Teaching of Mathematics in Japan.* Tokio, 1912. 16+239 pp.

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D. KIKUCHI. "Education in Japan," Monroe's *Cyclopedia of Education*, New York, Macmillan, vol. 3, 1912.

"System of Public Instruction in Japan." *Report of the Commissioner of Education for 1914–15*, Washington, 1915, vol. 1, pp. 749–771.

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[1] Prof. Hayashi informed me that the pension increment, one two-hundred-and-fortieth of the salary, is not allowed for the years of service in excess of 40.

XII. THE NETHERLANDS.

The Kingdom of the Netherlands has an area of about 12,600 square miles, and its population at the end of 1914 was about 6,340,000.

Every grade of education in the Netherlands is under the control and supervision of the State, the work of administration being handled by a special department under the ministry for the interior. So-called secondary schools (burgher schools, higher burgher schools, agricultural schools, and industrial, trade, and technical schools) were established by a law of 1863. This law requires that every commune with a population of 10,000 provide a burgher school. All of these are now organized as evening schools, and they, as well as the higher burgher schools (*Hoogere Burger Scholen*), are mainly intended for those engaged in industrial or agricultural pursuits.

The higher burgher schools are divided into two classes, those with a three-year course and those (about two-thirds of the whole number) with a five-year course. Pupils commence this five-year course at the age of 12 or 13 years, after having had six years of training in the primary schools.[1] The instruction in mathematics (which includes arithmetic, algebra, plane geometry, solid geometry, elements of plane trigonometry, descriptive geometry, geometric drawing, mechanics, and cosmography) occupies about one-quarter of the 30 to 32 recitation periods (50 minutes each) per week. Algebra is taught in Classes I–IV; geometry in Classes II–V. In algebra such topics as theory of indices, logarithms, progressions, compound interest, and equations of the first and higher degree in one or several unknowns are taken up.

The diploma of a higher burgher school entitles the pupil to go to the polytechnic school at Delft or to one of the universities to study medicine or natural science.[2] The examination for the diploma is decidedly severe. Within a period of nine days the pupils have to write 42 hours in the examination room: Algebra (3 hours), Dutch (3 hours), geometry (3 hours), French (3 hours), nature study (4 hours), bookkeeping (2 hours), trigonometry (3 hours), free-hand drawing (6 hours), mechanics (3 hours). This is followed by an oral examination, which includes certain subjects not mentioned in the above list. The examination is held at some convenient center, before a committee appointed by the provincial authorities. In some cases two or three Provinces are combined for this purpose. The examination lasts for three days, not more than three hours a day.

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[1] All pupils entering the higher burgher schools and the gymnasia, to which I shall presently refer, must pass an entrance examination. Usually about 25 per cent of those who try the examination fail

[2] For other departments of the universities, examinations in Greek and Latin must be passed.

Higher education, as defined by the law of 1876, is that given in the gymnasia (public and private), at the athenæum—later the communal university—at Amsterdam, and at the State universities. The pupils entering the gymnasium and higher burgher school are of the same age, and the courses of these schools are to a great extent parallel, although the duration of the course in the gymnasium is six instead of five years.[1] It is, accordingly, somewhat remarkable to find gymnasia classed with institutions of higher education. This classification of gymnasia is found only in the Netherlands. Every town with a population of 20,000 (and there are at least 30 such in the Netherlands) must provide a gymnasium unless specially relieved from the obligation. The affairs of each gymnasium are administered by a college of curators nominated by the municipal council. This council also appoints the teachers, upon the recommendation of the curators and the advice of the inspector, dismisses them when necessary, and fixes the rate of their salaries, subject to the approval of the minister of the interior.

The gymnasia prepare students to enter directly the various departments of the universities. During the first four years of the course this preparation is the same, but in both the fifth and the sixth year there are, along with hours common to all, certain hours for (*a*) the "humanist" alone, and (*b*) the "realist" alone. The common mathematical program in the fifth and sixth years for (*a*) and (*b*) includes discussion of quadratic equations, theory of indices, and solid geometry. But students of section (*b*) are also taught mathematics in three extra hours per week during the two years. They have such subjects as the progressions, logarithms, indeterminate equations of the first degree, permutations and combinations, determinants, probabilities, plane and spherical trigonometry, and elements of the theory of plane analytic geometry. They also review their arithmetic, algebra, and geometry, and are taught applications. The (*b*) courses in geometry include at times such topics as the theorems of Menelaus and Ceva, radical axes, centers of similitude, Euler's line, nine-point circle, prismatoid, Euler's theorem, harmonic ranges and pencils, poles and polars, and "Guldin's theorem." The mathematics of section (*b*) occupies the student for about one-sixth of his time.

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[1] Graduates of a higher burgher school with a five-year course are usually better prepared to take up the study of physics and mathematics in a university than are the graduates from a gymnasium.

The final examinations are conducted by the staff of each school, under the supervision of Government delegates, usually three in number. As a rule, the inspector is one of them. The examination is similar to that for graduates from the higher burgher schools, and covers practically all the studies of the course. These include Greek, Latin, Dutch literature, French, German, history, geography, mathematics, physics, chemistry, and natural history. The Dutch would, therefore, seem to have taken as a motto Lessing's saying: "Aus einem tüchtigen Philologen lässt sich alles machen."

In the Netherlands there are five universities. Besides the State universities at Leyden, Utrecht, and Groningen, there are the Communal and the Free Universities of Amsterdam. The Free University has no faculty of mathematical science and physics.

The mathematical instruction in the universities of the Netherlands varies to a certain extent, but in all it includes mathematical physics and theoretical mechanics. During the first two years (courses are reckoned by years, not semesters) the programs of study contain *higher algebra* (determinants, irrational and complex numbers, theory and methods of solution of equations of higher degree, linear substitutions, theory of invariants); *differential calculus* and an introduction to the *integral calculus; analytic geometry* of the plane and of space (lines, curves of the second degree, planes, surfaces of the second degree); *descriptive geometry* (methods of projection, applications to the theory of curves and surfaces).

The subjects of study in later years are very varied, but some of the principal ones are: Integral calculus, differential equations, theory of functions, general theory of curves and algebraic surfaces, differential geometry, calculus of probabilities, calculus of variations, theoretical mechanics, and mathematical physics.

The title of doctor is obtained after two academic examinations and the submission of a dissertation. The student generally presents himself for the first examination, called "the examination for candidature," after three years of study. For the candidate in mathematics and physics this examination is on higher algebra, analytic geometry, descriptive geometry, differential calculus; astronomy; and physics. In the second examination, the examination for the doctorate, the candidate is examined on integral calculus, theory of functions, calculus of probabilities in its applications to physics, theoretical mechanics, and physics. It is especially notable that even for the mathematicians, higher geometry is not a subject for examination.

For students in mathematics and astronomy the course is much the same as in mathematics and physics.

Candidates generally present themselves for the examination for the doctorate three years after the examination for candidature, but the total period of the study for this degree is often more than six years, since the time ordinarily spent on the dissertation is one or two years. Occasionally a student accomplishes the work for this degree in less than six years. It occurs more frequently, however, that a student passes the examination for the doctorate and then presents his dissertation one or several years after having left the university.

According to a law of 1905 the student who has successfully passed the examination for the doctorate has the right to teach in a gymnasium or other secondary school, in one of the subjects in which he was examined. It thus happens that those who have arrived at professorships in this way have received an admirable scientific preparation from a theoretical point of view, but have had absolutely no practical preparation for the chairs which they have been appointed to fill. In most cases the future teacher is transferred directly from the university to the school, without ever having taught and without any knowledge of theoretical and practical pedagogy. His only experience is what may be gained by conducting from time to time, in the presence of a professor, a lecture on some mathematical subject, either on a paper which has appeared in a periodical or on a subject chosen by the student or proposed by the professor. Through these lectures and the criticisms to which they lead the student becomes somewhat accustomed to the method of formulating personal scientific research; but for development as professor these lectures have slight value, since the subject of a conference is almost invariably taken from some part of higher mathematics, and but rarely is a scientific treatment of elementary questions given.

Those who have passed the examination for the doctorate are not, however, the only ones who have a right to teach in secondary schools. The law of 1863 established a series of State examinations leading to a Certificate of Capacity for secondary teaching. For mathematics and mechanics there are two examinations, of which the first, examination *A*, accords the right to teach the branches of this examination in a secondary school with a course of three years, while the second, examination *B*, accords this right for a secondary school with a course of five years. Examination *A* includes arithmetic, algebra, plane geometry, solid geometry, plane and spherical trigonometry, principles of descriptive and analytic geometry, principles of theoretic and applied mechanics, machinery and technology, physics, chemistry, cosmography, geology, mineralogy, botany, and zoology. In the 50 years that the law has been in force a very small number of persons have passed this exceedingly elaborate examination. But the law also permits special certificates of capacity for mathematics alone, for theoretical mechanics, machinery, technology, etc. Thus examination *A* is decomposed into four less onerous examinations, and the candidate who has passed any one of them may teach the branch named in a secondary school with a three-year course. Examination *B* includes descriptive geometry, analytic geometry, differential and integral calculus, theoretic and applied mechanics. Those who have passed the two examinations *A* and *B* completely may teach mathematics and mechanics in a secondary school with a course of five years.

Those who present themselves at these examinations have rarely if ever attended any course in mathematics or theoretic mechanics. The majority of the candidates have been prepared by private tutors or by personal effort. The percentage of failures is consequently very high.

The salaries of directors of higher burgher schools range from 2,250 florins (with home) to 4,000 florins ($904.80 to $1,608) per annum; those of professors from 1,000 florins to 3,050 florins ($402 to $1,225).

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XIII. ROUMANIA.

Roumania contains about 7,500,000 inhabitants.

The general control of its education is vested in the minister of public instruction, but other ministers have charge of schools pertaining to their special provinces. The ministry of public instruction is organized in three departments: (1) Primary instruction, including primary normal schools; (2) commercial, technical, and private schools; (3) secondary and higher education.

The real organization of secondary education dates from the law of 1898, which was modified in 1909 and again in 1910 in the direction of increasing the modern character of the curriculum. In accordance with these measures secondary education is arranged in two cycles of four years each: The lower course (first to fourth, I–IV) and the higher course (fifth to eighth, V–VIII). Those secondary schools which have only the lower course are the gymnasia. Those with both cycles are the lyceés. The higher course is organized in three parallel sections after the model of the French lycée; namely, science-modern languages, Latin-Greek, and Latin-modern languages. In each section the material forms a unit of study. At the end of the eighth class the pupils who successfully pass the final examinations obtain the "certificate of secondary study." In general, the pupils leave the lycée at the age of about 19 years. They are then prepared to enter various higher schools, including the universities, of which there are two, one at Bucharest, the other at Jassy.

In the first cycle the subjects taken up in mathematics are: Practical and rational arithmetic, elementary geometry (plane and solid), elementary algebra, and notions of bookkeeping and surveying. With regard to the second cycle, reference is made only to the science-modern language section from which the future mathematicians come. The special object of the mathematical work in the second cycle is to develop the reasoning powers. Because of this some of the more subtle questions of arithmetic are introduced. The study of algebra is developed at length in courses extending through all four years. This study includes convergence and divergence of series, the number *e*, derivatives of exponential, logarithmic, and circular functions, and Horner's method of solution of equations with numerical coefficients. In plane and solid geometry such questions as transversals, harmonic division, poles and polars with respect to a circle, areas of polygons and of a circle, and area and volume of a sphere are taken up with many problems and applications. Then there are also plane trigonometry in VI, descriptive geometry and mechanics in VII, analytic geometry and cosmography in VIII. Mathematics occupies 6 hours out of 28 a week (21.4 per cent) in V and VI, 5 out of 28 (17.9 per cent) in VII and VIII.

For the pupils in the science-modern languages section who specialize in mathematics there is a special publication *Gazeta matematica*, which has appeared since 1895. It is somewhat similar to the *Revue de mathématiques spéciales* prominent in the French lycées. Quite apart from the obligations connected with their courses of study, the mathematical pupils of the section not only solve the problems in pure and applied mathematics in the Gazeta, but also propose others and contribute notes and articles. The progress of mathematical science in Roumania stands in intimate relation to this review.

Such then is the nature of the work which the mathematical professor has to conduct. There remains the consideration of his preparation for the work.

The directors and professors in the secondary schools are university men and receive their appointments from the Government. Since the law of 1898 the mathematical professors are appointed from among those who have passed the "examination of capacity," which is held every three years. To register for this examination it is necessary to have (1) the diploma of *licence ès sciences mathématiques* of a university; (2) the certificate of a pedagogic seminar.

"The students who have passed the examination of licence ès sciences mathématiques have sufficient theoretical preparation to become good professors in secondary education," as it is modestly expressed by Prof. Tzitzéica. The examinations for the licence are in higher algebra, analytic geometry, descriptive geometry, differential and integral calculus, theory of functions, mechanics, and astronomy. These examinations require at least three years of preparation.

During his university studies and afterwards the future mathematical teacher takes a course in pedagogy at the university. He also commences at the same time his practical training at a pedagogic seminar. The pedagogic seminarien in connection with the universities were created by the law of 1898.

The examination of capacity consists of (1) three written examinations on the elementary material of secondary education and on the more advanced material of the licence; (2) two oral examinations, one on mathematical questions proposed by the jury, the other on pedagogy; and (3) two practical examinations—that is to say, two lessons such as the candidate might deliver to pupils in a lycée.

In order to claim a teaching position as a right, one must have passed an examination of capacity for a secondary specialty. For example, physics or geography may be offered with mathematics.

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XIV. RUSSIA.

It has been estimated that the Empire of Russia contains more than 182,000,000 people. Since the treaty of Portsmouth its area, exclusive of inland waters, is about 8,400,000 square miles.

Finland (*q. v.*) has a separate system of public schools much more highly developed than that of the remainder of Russia, where the general education of the people has been of a very low order. Except in certain parishes of the Baltic provinces, education is not compulsory. The numerous central authorities in connection with Russian education include the ministry of public instruction and the Holy Synod. The former controls the universities and the great majority of the secondary schools of all classes.

The secondary or middle schools include:[1] (1) Seminaries for teachers, of which the ministry established 63[2] in 1891 for the preparation of teachers for certain primary schools; (2) institutes for teachers (33 in number in 1914) which prepare teachers for another class of primary schools; and (3) establishments such as the progymnasia (of which there were 29 in 1914), gymnasia (441), "real schools" (284), and technical schools (68 in 1910),[3] under the control of the ministry of public instruction and providing general instruction for the youth.

The progymnasia are incomplete gymnasia with four or six classes instead of eight classes (I–VIII), one for each year of the course. Among secondary schools, only the gymnasia and real schools are considered here. Bobynin has given the mathematical programs of the seminaries and institutes for teachers.

GYMNASIA.

Pupils normally enter the gymnasia at the age of 10 years. In the explanatory remarks prefatory to the program of the course of mathematics in the gymnasia for boys, the ministry of public instruction sets forth the object of the course:

> Mathematics as an exact and abstract science furnishing a simple, and consequently appropriate, means of assuring suitable development of the mind constitutes one of the foundations of general instruction. The essential object of study at the gymnasium being the intellectual development of the pupil, the mathematical instruction should be characterized, before all else, by the thoroughness and systematic rigor of a theo-

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[1] Bobynin, 1903 (see bibliography); and A. T. Smith in *Cyclopedia of Education*, edited by Monroe, in article on Russia.

[2] Since increased, according to a report of Jan. 1, 1914, to 122 (*Statesman's Year-Book*, 1917).

[3] In 1912 there were 30 technical schools of secondary school grade.

retic course; practical applications should be introduced, first, as illustrations of the theory, and then, to habituate in computations.

The gymnasia of the ministry of public instruction are of two types: (1) Those in which only one ancient language, Latin, is taught; and (2) those in which two ancient languages are taught. There were only five of these latter gymnasia in 1910.

While the whole number of hours devoted to mathematics in these two types of gymnasia is not the same, the programs are identical. The subjects taught are arithmetic, algebra, geometry, trigonometry, physics, mathematical geography (cosmography), and notions of mechanics.

Arithmetic is taught in Classes I-III and reviewed in Class VIII, where certain parts, omitted earlier on account of their difficulty, are taken up. In the third year topics of discussion are: Ratio and proportion, problems relating to the so-called rule of three; interest and proportional parts.

Algebra (III-VIII).—Some of the matters taken up in Classes VI-VIII are: Progressions and logarithms; calculation of compound interest; indeterminate equations of the first degree in two unknowns; continued fractions; binomial theorem; resolution of a system of equations by the method of Bézout.

Geometry (IV-VI), with review in VIII.—In V-VI the student is instructed in the measurement of lines and angles; proportionality of segments; similitude of triangles and polygons; regular polygons; notion of a limit; length of the circumference; notions on the calculation of π; area of rectilinear figures, of the circle and of its parts; simple problems of instruction, and numerical applications for each article of the program; regular polyhedra; evaluations of area and volumes of prisms and pyramids; cylinder, cone, and sphere, evaluation of their areas and volumes.

Trigonometry (VII-VIII).—Elements of plane trigonometry, including the use of tables, solutions of triangles, calculation of areas and applications to problems in surveying. Trigonometric equations and inverse trigonometric functions are not discussed.

Cosmography (VIII).—Rotary motion of the celestial sphere; rotary motion of the earth; true shape and size of the earth; apparent annual movement of the sun; annual movement of the earth round the sun; measurement of time; constitution and dimensions of the sun; moon; eclipses; planets; comets; law of gravitation; tides.

Mechanics (VI, VIII).—Motion and force—laws of motion, law of inertia, law of relative motion,equality of action and reaction; force as a cause of motion and of pressure; resistance of motion (friction); equilibrium of forces; composition and decomposition of forces; levers. Theory of gravitation. Theory of motion—uniform motion; velocity; acceleration; uniformly accelerated and retarded motion; motion of a projectile; notions regarding curvilinear motion and centrifugal force; pendulum. Theory of energy—work; lever; pulley; inclined plane; toothed wheels; kinetic and potential energy; transformation of mechanical work into heat and inversely; principle of conservation of energy.

In most gymnasia the pupils have the same teacher of mathematics in all of their courses. This arrangement seems to cause the pupil to think of the bonds uniting one course to another. As to the connection between mathematics and physics and mechanics, the courses in physics and mechanics (as well as in cosmography) are conceived in such a way as constantly to give the pupil occasion to apply his knowledge and his experience of mathematics.

About one-third of the pupil's time in the ordinary gymnasium is devoted to the study of Latin and Greek, and about one-fifth to mathematics and physics.

At various stages in his course the pupil is required to pass written and oral examinations. In the final examination the written portion in mathematics lasts five hours and requires the solution, with detailed explanations, of two problems, one in algebra and the other in trigonometry applied to geometry. The mathematical portion of the oral examination is in arithmetic, algebra, solid geometry, and trigonometry. The student who has successfully passed this examination receives a certificate of maturity (attestat zrelosti). The bond between secondary and higher education is formed by the requirement of this certificate for admission to the universities and that of either the gymnasium or the real school for admission to the higher technical colleges.

"REAL SCHOOLS."

The normal age of entrance into these schools is 10 years. Most schools now possess, in addition to the former regular six classes (I–VI), a seventh class (VII). Each class lasts for a full year.

The subjects common to all real schools are: Russian, with Slavonic; modern languages—German, French; geography; history; mathematics and geometric drawing; natural history; physics; drawing; calligraphy. In a comparison of Real schools with the gymnasia, it is to be noted that logic and the classical languages have disappeared to make room for more of science and of modern languages.

The students of the real school cover in six years about the same amount of mathematics as those in the gymnasia cover in eight. Special reference may be made, however, to the five-hour course of mathematics given at many real schools in the supplementary seventh year. The subjects taught are arithmetic, algebra, trigonometry, elements of analytic geometry, and infinitesimal calculus. The leading topics taken up are:

Arithmetic: Principal propositions on factoring of numbers; the highest common divisor of two numbers; solution in positive integers of indeterminate equations of the first degree in two unknowns.

Algebra: Complex numbers; fundamental properties of an integral function and its roots; special cases, the functions x^n-a^n and $ax^{2p}+bx^p+c$; discussion of equations of the first degree with one unknown and of a system of two equations of the first degree with two unknowns—indeterminate case, contradictory equations.

Geometry: Relative positions of lines and planes in space; principal properties of dihedral and polyhedral angles; regular polyhedra; measurement of the surface and volume of the right cylinder, the right cone, and the sphere and its parts; examples leading to computation and construction problems.

Trigonometry: Inverse circular functions; trigonometric equations; etc.

Analytic geometry: Rectangular and polar coordinates; transformation of coordinates; circle, parabola, ellipse, hyperbola; equation of ellipse and hyperbola in bipolar coordinates; loci; diameters.

Calculus: Fundamental theorems in limits; application to the measurement of circumference and area of circles, of the surface and volume of cylinders, cones, and spheres; $\underset{z=0}{\text{limit}}\frac{\sin z}{z}$; $\underset{n=\infty}{\text{limit}}\left(1+\frac{1}{n}\right)^{n}$; differentials of algebraic and transcendental functions; geometric explanation of Rolle's theorem; Lagrange's theorem; increasing and decreasing functions; equations of tangents and normals of the conic sections; definite integrals.

Since 1911, students who have satisfactorily completed the seven years' course of the real school are admitted to the universities without examination. Teachers in the real schools are, for the most part, graduates of a university in the subject which they teach.

To form a true conception of secondary education in Russia, one should bear in mind that, taken as a whole, the boys attending the secondary day schools are drawn from a lower social stratum than are those attending such schools in England or France. As a rule neither the children of the aristocracy nor those of the higher officials attend the gymnasia; the former are educated for the most part by private tutors, the latter in special schools open only to the nobility.[1]

THE UNIVERSITIES.

In Russia, exclusive of Finland, there are 10 universities. The largest and oldest is at Moscow; The others, in order of foundation, are at Yuriev (formerly Dorpat), Khazan, Kharkof, Petrograd, Kief, Odessa, Warsaw, Tomsk, and Saratov.[2] The last was founded in 1909, and neither there nor at the University of Tomsk has a faculty of physics and mathematics been established.

While secondary education in Russia still leaves much to be desired, the standard of teaching in the universities is, on the whole, very high, and may be compared to that of the German universities.[3]

The scholastic year consists of about 27 weeks of lectures, and the course of study at the university covers four years.

The Russian faculty of physics and mathematics is composed of two sections: The section of mathematical sciences and the section of natural sciences. With the exception of general courses in physics and chemistry given to students in both sections, all subjects in the two courses are different.

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[1] This paragraph is equivalent to what Darlington states in this connection on pp. 347–348 of his report (which sought to represent actual conditions at the end of 1904). The Bureau of Education at Washington has, however, kindly volunteered the information that "about 50 per cent of Russian gymnasium students are sons of nobility and merchants. 'Aristocracy' is represented by at least 20 per cent of the students. The special schools for aristocracy have long ago become insufficient and now are discarded." The bureau states that the authority it quotes is: Russia, Ministry of Public Instruction, Report for 1912, [in Russian], Petrograd, 1915, pp. 50 and 51.

[2] "A Popular University bearing the name of Gen. Alphonse Shaniavsky, who has given the funds necessary for its creation, has existed at Moscow since autumn, 1908. In 1916 a Woman's University was created at Petrograd with the power of conferring the degree of doctor."—*Statesman's Yearbook, 1917.*

[3] *Encyclopaedia Britannica*, 11th edition, 1911, Article "Russia." W. S. Jesien has recently reported great improvement in Russian secondary education during the past decade.

Since 1906, several universities, including those at Moscow and Petrograd, have divided the studies in the mathematical section into three groups: (1) Mathematics and analytic mechanics; (2) astronomy; and (3) physics, subdivided into (*a*) physics and (*b*) physical geography and meteorology. The student may elect to take up the studies of any one group.

The courses for the mathematics and analytic mechanics group at the University of Petrograd in 1909–10 were as follows:

Semester 1.—Spherical trigonometry; introduction to analysis; analytic geometry; exercises on analytic geometry; higher geometry or descriptive geometry; physics of molecular forces; descriptive astronomy. Recommended: Course in general chemistry.

Semester 2.—Analytic geometry and exercises; differential calculus and exercises; higher geometry or descriptive geometry; descriptive astronomy; physics; heat. Recommended: Course in general chemistry.

Semester 3.—Higher algebra; applications of differential calculus to geometry; integration; spherical astronomy; optics; acoustics and electricity.

Semester 4.—Higher algebra; integration; geometric applications of integral calculus; exercises on the integral calculus; statics, optics, acoustics, electricity; spherical astronomy.

Semester 5.—Definite integrals; integration of ordinary differential equations; finite differences; kinematics.

Semester 6.—Definite integrals; integration of ordinary differential equations and the calculus of variations; theory of numbers; dynamics of a particle and exercises.

Semester 7.—Partial differential equations; finite differences; calculus of probabilities; elliptic functions; mechanics of systems and exercises. Recommended: Theoretical astronomy.

Semester 8.—Partial differential equations; calculus of probabilities; theory of attraction, hydrostatics and hydrodynamics. Recommended: Celestial mechanics.

In addition to the general and recommended courses there are certain special courses not given every year, for example:

1. Theory of Abelian integrals (1906–7).
2. Theory of surfaces (1907–1909).
3. Analytic theory of differential equations (1907–1910).
4. Vector analysis (1908–1910).
5. Historical and critical review of the principles of rational mechanics (1908–1910).

These courses are given, for the most part, by the Privatdocenten.

The final examination for the students in the faculty of science is conducted by a commission appointed by the State. The examinations are both written and oral. The programs of the State examinations divide university courses into two classes: (1) Fundamental or principal courses, (2) complementary courses. The programs of the principal courses are the same for all universities and contain only the most essential and elementary parts of the four sciences (mathematics, mechanics, physics, astronomy), which are taught in the mathematical section of the faculty. In these subjects there are two written and five oral examinations. The programs of the complementary courses are not fixed. The choice of two complementary courses is made by the student himself. In mathematics he may choose theory of numbers, theory of elliptic functions, higher geometry, or some other course of three semester hours per week. The examination is oral.

A student who passes all the examinations receives a diploma of the first or second grade, which gives certain civil rights, such as the right to teach in the secondary schools without any special examination. The diploma conferred by the State examining commission is not technically a degree, though it is fully equivalent in value to the B. A. degree conferred by British or American universities. With this diploma the great majority of students rest satisfied. Only a select few remain at the university to prepare for a degree, and most of these do so with the view of ultimately obtaining a professorial chair. There are two degrees, magister and doctor; but discussion of these is beyond the scope of this sketch.

TEACHERS IN SECONDARY SCHOOLS.

Every teacher of mathematics in a gymnasium under the control of the ministry of public instruction must be a graduate of the mathematical section of the faculty of sciences in a Russian university. Until very recently such a graduate had no training in pedagogy and no practice in teaching when he first presented himself at a gymnasium as a professor. In 1909, however, a provisional set of courses for the preparation of teachers of mathematics and other subjects was organized in the educational district of Petrograd. This plan has been followed by other educational districts.

At Petrograd the courses are under the direction of a council composed of the directors of establishments of secondary education and presided over by the inspector of the district. Information issued to pupil-teachers by the council includes the following:

1. The courses of one year in duration are especially designed to give practical preparation to teachers of mathematics in secondary schools.

2. The courses are open to those students who have a diploma from the mathematical section of a faculty of science and are bearers of a certificate of good conduct.

3. The more necessitous of the candidates for the course receive a stipend of 300 rubles ($156). In addition to this assistance in money, student teachers may, under certain circumstances, earn money as tutors, or as substitute teachers during the absence of the incumbent of a chair.

4. Pupil teachers of the same specialty are sent as probationers, in groups of two or three, into gymnasia and real schools.

5. The immediate direction of the work and courses of the pupil teachers is confided to chiefs of probationers chosen from the teaching personnel of the establishment by the administration of the district.

6. The obligations of the pupil teachers are the following:

(i) To study carefully, in works and books indicated by the chiefs of the probationers, the parts of their specialty which figure in secondary education, as well as the methodology of the subject.

(ii) To attend lectures by the chiefs of the probationers or by other professors in logic, psychology, history of pedagogy, pedagogy, and to make report of these lectures to the chief.

(iii) To deliver lessons, as often as possible, before the chiefs of the probationers, other professors, and other probationers in the specialty, in accordance with a plan arranged in advance and approved by the chief.

(iv) To attend the trial lessons of other probationers of their group.

(v) To take part in the discussion of the trial lessons of probationers of their group.

(vi) To prepare papers on questions of general pedagogy, studies of methodology in the specialty, reviews of textbooks.

(vii) To seek to understand the child's mind, by contact with and observation of pupils in general, or of a particular group, while engaged in recreations, games, excursions, and walks.

(viii) To attend the pedagogic council.

(ix) To attend the conferences and pedagogic discussions (three times a week) and make report.

7. In case these requirements have been met, the probationers are "éliminés du contingent" and are qualified to teach.

At the end of the school year, in a general conference of the committee and the various chiefs of probationers, the results of the work of the year and the characteristics of the probationers are discussed.

The preparation of teachers in the real schools is practically the same as of those in the gymnasia.

Apart from the question of supply, the two main difficulties which remain to be solved in connection with the teaching staff of the Russian secondary schools are (1) the question of remuneration and (2) the question of professional training. An attempt to dispose of this latter difficulty has been described above. With regard to the first point there seems to be general agreement, Mr. Darlington writes, that the present rate of remuneration, which was fixed 30 years ago, is not sufficiently high either to attract the best talent into the teaching profession or to enable teachers to give their undivided attention to their school duties. An assistant teacher in a State secondary school, teaching 30 hours a week, which is accepted as the normal limit, receives 1,830 rubles (about $915) a year for the first five years of his service, after which his salary is increased by 150 rubles, thus reaching 1,980 rubles (about $993) a year in all. Extra payments (e. g., for correcting exercises and acting as "class tutor") may raise the remuneration to 2,230 rubles a year, but in any ordinary case, so long as he continues to be an assistant teacher, his salary remains as above stated from the sixth to the twenty-sixth year of his service, when he receives his pension. An income of less than 2,000 rubles a year may be sufficient to enable an assistant teacher to live in a manner suitable to his position, so long as he remains a bachelor; it is wholly inadequate to the needs of a married man with a family. With the most rigid economy a moderate-sized middle-class household can not be maintained, at any rate in the larger towns of Russia, on less than 3,000 rubles a year. A married teacher is therefore under the absolute necessity of earning on an average an extra thousand rubles a year in addition to his official salary in order somehow to keep soul and body together and provide proper education for his children.

The salary of an ordinary professor in a Russian university is 3,000 rubles a year, of an extraordinary professor 2,000 rubles.

The pension rights attached to the teaching profession in the higher and secondary branches are very considerable in Russia. Twenty years of work gives to such a teacher a right to a pension equal to half his salary; 25 years' service entitles him to a pension equal to his full salary. Moreover, if the teacher is prevented by shattered health or some incurable disease from continuing in the exercise of his profession, he is still more generously treated.

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XV. SPAIN.

At the close of 1913 continental Spain had an area of about 194,000 square miles and a population of over 19,600,000.

The whole system of public instruction is controlled by the minister of education, an advisory council, and a corps of inspectors, one for each of the 49 Provinces or administrative divisions of the country. The secondary schools and universities are intimately associated, by reason of the fact that Spain is divided into 11 university districts, the secondary and higher education in each of which is under the control of a rector. He is assisted by a university council which acts in an advisory capacity.

The State secondary schools, of which there must be one, at least, in every Province are styled institutos de segunda enseñanza. The colegios de segunda enseñanza are boarding schools in charge of local authorities and are feeders for the institutos. Pupils who enter the institutos are about 10 years of age. The general course is divided into two parts, one part covering two years and the other four. In the first part the only subjects of a mathematical nature are arithmetic and drawing. Algebra, geometry, and trigonometry are studied in addition to arithmetic in the second part. Physics and chemistry are also taught in this part. The student who has successfully completed the six years of study and passed the corresponding State examination is called a bachiller en artes, and is entitled to proceed to a university.

The University of Madrid has the largest attendance; the University at Salamanca is the most ancient. Other universities are those established at Granada, Sevilla, Barcelona, Valencia, Santiago, Zaragoza, Valladolid, Oveido, and Murcia.[1]

The bachiller who wishes to prepare himself to teach mathematics in the secondary schools must study in the faculty of sciences of a university and secure the title of *licenciado* (licentiate). At Madrid candidates may then proceed to the doctorate; Barcelona and Zaragoza are the only other universities which have a faculty of science preparing completely for the licenciatura.

The mathematical studies leading to the licenciatura are as follows:

1. *Mathematical analysis.*—First and second courses, supplementary to the work in the institutos. The first course comprises theories of arithmetic not explained in

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[1] This university was established in 1915 or 1916. *Cf. The Statesman's Yearbook*, 1915–1917.

secondary education, the whole field of elementary algebra, plane and spherical trigonometry with analysis of circular functions. The second course deals with higher algebra; and the general theory of equations, as well as an introduction to modern higher algebra, is presented. During one year at the University of Madrid, for example, this introduction dealt with the theory of binary forms (discriminants; Jacobians, Hessians, and Wronskians; linear substitutions; invariants and covariants; canonical forms).

2. *Metric geometry.*—This geometry is simply the ordinary Euclidean geometry modified by the use of modern synthetic methods. The course in the faculty of sciences is divided into two parts: The first deals with fundamental theories, those on which the theorems of all previous questions are based; the second consists in studies of each group of figures in detail, without losing sight of the groupings which facilitate the employment of the principles of duality, projectivity, etc.

(*a*) *Fundamental theories:* First notions; angles; perpendiculars and parallels; relation between the elements of triangles and of trihedral angles, isosceles or scalene; distances and inclinations large and small; elementary cases of symmetry and of equality of triangles, trihedrals, and tetrahedrons; equality and orthogonal symmetry in general; geometric loci; circle, cone, and sphere; proportional lines; similar figures; products of segments in triangles; concept of length of curves in general and of the areas of conics; plane and spherical trigonometry sufficient for the solution of right triangles; orthogonal projections.

(*b*) *Studies:* More complete consideration of each of the following figures: Ranges of points, pencils of rays or of planes; their cross ratios and projection; segments and angles; triangles and trihedral angles; quadrilaterals, tetrahedral angles, and tetrahedrons; ordinary polygons, polyhedral angles, and polyhedrons in general, and in particular those which are regular and semiregular; prisms and cylinders; pyramids, prismatoids, cones, and spherical figures; systems of circles, of cones, and of spheres; particular determination of length, of areas, and of volumes; their comparison and proportionality; homology, homothety, involution, and symmetry in general; polarity of a circle, of a cone, or of a sphere; inverse figures; stereographic projection.

3. *Analytic geometry.*—This course is based on projective methods and is especially developed at Madrid.[1]

4. *Elements of infinitesimal calculus.*—This course includes a discussion of theory of limits, continuity, orders of infinitesimals; derivatives and differentials of functions of one or of several variables; change of variables; hyperbolic functions; Legendre's polynomials and developments into series by formulæ of Taylor, Maclaurin and Lagrange; maxima and minima; elements of integral calculus; differentiation and integration under the integral sign with application to the calculation of definite integrals and of the Eulerian integrals. In some programs this first part of the calculus course concludes with a discussion of curvilinear and surface integrals and of integrals in the formulæ of Green, of Stokes, and of Dirichlet, and their applications in mechanics and physics.

5. *Cosmography and physical geography.*
6. *Geometry of position.*
7. *Descriptive geometry.*
8. *Rational mechanics.*
9. *Spherical astronomy and geodesy.*

The title of licenciado in mathematical science is obtained by a candidate after three examinations are successfully passed: (*a*) A written examination on two questions drawn, by lot, from those proposed by the tribunal; (*b*) an oral interrogation by the three judges, for half an hour each; (*c*) a practical exercise consisting in the solution of a problem in descriptive geometry or in rational mechanics drawn, by lot, from the problems of the questionnaire, and response to observations of the tribunal.

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[1] J. REY PASTOR, *Fundamentos de la geometria proyectiva superior.* Tomo 1, Madrid, 1916. 22+444 pp. *Cf. Bulletin des sciences mathématiques* tome 41, 1917 p. 229.

The examinations for secondary school professorships are open only to licentiates and comprise: (1) A written examination four hours in length, consisting of the development of two themes of a questionnaire; (2) an oral examination consisting of response to five questions drawn by lot; (3) a practical exercise; and, after the exclusion of those who have not met with success, (4) delivery of a lesson after eight hours of preparation to be criticized by one or two opponents; and (5) exposition of a given topic and replies to criticisms of the tribunal.

The best mathematical positions in the secondary schools are obtained by the doctors of mathematical sciences, who are also eligible for positions on the faculty of sciences of a university. To prepare for the doctorate it is necessary to follow courses at the university in higher analysis, advanced parts of geometry, astronomy of the planetary system, and mathematical physics, and to present a memoir on a subject selected by the candidate and satisfactorily sustained against objections on the part of the tribunal.

The titles of some advanced courses offered to those preparing for the doctorate may be given: Ordinary differential equations; calculus of variations; integral equations; quaternions; functions of a complex variable; elliptic functions; Galois's theories.

It usually takes four years in the university to pass the licenciatura, and one extra year, for those who are apt scientific investigators, to make the doctorate.

The professors of secondary and higher education are appointed by the King; in the case of the institutos one of the professors is appointed as director.

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XVI. SWEDEN.

The area of Sweden is a little less (excluding the lakes) than 170,000 square miles, and the population was estimated to be on December 31, 1916, about 5,757,000. Of these, all but about 100,000 belong to the established Lutheran Church. It is, therefore, not surprising to find church and school both placed under the administration of the Ecklesiastikdepartementet, or the ecclesiastical department. The trend of circumstances recently has been toward their separation. It was not so long ago that the chapters (*domkapiteln*), composed of ministers and laymen, were still the local boards of administration, not merely of ecclesiastical affairs, but also of affairs relating to the secondary schools and to the elementary school system. Since 1905, however, the central government of the State secondary schools and equivalent educational establishments receiving State aid has been in the hands of a board called the Royal Board of Secondary Schools; the result has been that the powers of the chapters as regards these educational institutions have been very considerably curtailed. In 1913, by the establishment of a central board for the elementary schools, these also were placed under the administration of expert laymen.

The royal board of secondary schools deals with such matters as curriculum, discipline, training of teachers, appointment of teachers, etc. It is also the duty of its members to inspect the schools personally and to give instruction and advice in the course of their inspection.

Since 1905 the State secondary schools for boys have been classified into two groups: Realskolor or modern schools (independent), and högre allmänna läroverk, each comprising a realskola and a gymnasium.

There are 77 secondary schools for boys (allmänna läroverk), 38 of these are högre allmänna läroverk and 39 are independent realskolor. Among the latter, 18 are coeducational schools. There is no independent State gymnasium.

Into the realskola, which has six one-year classes (one, the lowest, to six), the boy may enter at 9 years of age.[1] The course at the gymnasium is based upon the work of the five lower classes of the realskola and is divided into two "sides"; the Latingymnasium and the realgymnasium, each consisting of four one-year classes called "rings" (I to IV). The boys in the sixth class of the realskola are thus of the same age as those in the first ring of the gymnasium.

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[1] Note that the secondary education is built on the third year of primary education, instead of the fifth, as in Denmark. The primary schools give a six-year course, while in some cases continuation courses are offered for three years longer.

REALSKOLOR.

Mathematical instruction, which occupies about one-sixth of the pupil's time, is here given during five hours weekly in each of the classes except in the first and fifth, where it occupies four hours. The subjects taught are arithmetic, algebra, and geometry. In the sixth class the pupils are instructed in: (1) *Algebra*—evolution and involution, proportion, equations of the first and second degree with one unknown, graphs, and problems; (2) *geometry*—geometric exercises and amplification of preceding course, which has dealt with circles and polygons and simple problems. Drawing exercises of the Realskola include, in class 4, geometric construction of parallel lines, triangles, parallelograms, and polygons; in class 5, drawing of regular figures, such as the ellipse and limaçon; elements of descriptive geometry; in class 6 further exercises in descriptive geometry.

In 1904–5 about 60 out of 75 schools used Euclid's Elements as textbook in geometry. Four years later, with the development of the more practical or modernized scheme of secondary education, about 60 out of the 75 schools had adopted texts similar to the school geometries now so common in England.

General scheme of studies in a realskola.

Subjects.	Classes.					
	1	2	3	4	5	6
Religion	3	3	3	2	2	2
Swedish	5	5	6	4	3	3
German	6	6	6	4	4	3
English	......	......	......	5	5	4
History	2	3	3	3	3	4
Geography	2	2	2	2	2	2
Mathematics	4	5	5	5	4	5
Biology	2	2	2	1	2	2
Physics	......	......	......	2	1	2
Chemistry	......	......	......	......	2	1
Writing	2	2	1	......	......	......
Drawing	1	1	2	2	2	2
Total number of hours a week	27	29	30	30	30	30

The final goal of the realskola is a State examination (Realskolexamen), which gives admittance to various technical schools and to schools of forestry, agriculture, and mining, and qualifies for various appointments in the post office, railway or telegraph service, etc. The examination consists of two parts, the one written and the other oral. The questions of the first part (in Swedish, German, English, and mathematics) are the same for the whole country and the requirements are moderate.

GYMNASIA.

In 1913 about 57 per cent of the pupils in the gymnasia were in attendance at the realgymnasia.

The number of class periods per week in the realgymnasium (including gymnastics, fencing, singing, and religious instruction) is 38 to 41, of 45 minutes' duration. There must be a pause of 10 minutes between two periods. About one-quarter of the total time, apart from instruction in gymnastics, fencing, etc., is given to mathematics and drawing. In order to avoid overpressure and to permit of a pupil's devoting himself to some special study for which he displays marked aptitude, some options (*valfrihet*) are allowed in the last two years of the gymnasium course.

The extent of requirements in the different rings of the gymnasium may be seen in the following table:

Subjects.	The realgymnasium.				The Latingymnasium.			
	Ring I.	Ring II.	Ring III.	Ring IV.	Ring I.	Ring II.	Ring III.	Ring IV.
Religion	2	2	2	2	2	2	2	2
Swedish	3	2	3	3	3	2	3	3
Latin	......	......	......	......	6	6	6	6
German	2	2	2	2	2	2	2	2
English	3	3	2	4	2	2	2	2
French	......	4	4	4	......	4	4	4
History	3	3	3	3	3	3	3	3
Geography	2	1	......	......	2	1	......	......
Elements of philosophy	......	......	1	1	......	......	1	1
Mathematics	7	6	6	6	5	4	[1]4	[1]5
Biology	1	2	2	1	1	2	2	1
Physics	3	2	4	3	2	1	2	2
Chemistry	2	2	2	2	......	......	......	......
Drawing	2	2	2	2	2	2	2	2
Total number of hours a week	30	31	33	33	30	31	33	83

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[1] Those pupils who have elected Greek (7 hours a week) in Ring III drop mathematics, drawing, and one hour of English; in Ring IV Greek (7 hours) is then substituted for mathematics and drawing.

As to mathematics, instruction in a realgymnasium includes: (*a*) *Algebra*—theory of indices, logarithms, arithmetical and geometrical series, compound interest; (*b*) *geometry*—proportion applied to geometry, problems (especially in plane mensuration), solid geometry; (*c*) *plane trigonometry*—simple computations in connection with right and oblique triangles; (*d*) *analytic geometry*—curves of the second degree; the notion of a derivative is made clear and much emphasis is laid on graphic representation of functions.

The course in a gymnasium is concluded with a final examination (studentexamen, or afgångsexamen, or maturitetsexamen) which, in either "side," entitles those who have passed it to matriculation at the universities. Examination commissioners called "censors" are appointed by the Government to superintend each examination.

They are chosen for the most part from professors of the universities, and usually number about 18. The censors are assisted by "examiners," who are the teachers of the schools; the examiners always act under the direction of a censor and in his presence. Questions for the written part of the examination are drafted by the censors but must be approved by the royal board of secondary schools. This examination takes place simultaneously in all the schools some weeks before the oral examinations and lasts four or five days.

The written examinations in both "sides" include Swedish, modern language, and mathematics, and in the realgymnasium physics, in the Latingymnasium Latin. French may be substituted for either of the "modern languages," which are German and English. The single examination in mathematics lasts six and one-half hours. The paper contains eight or nine questions. An adequate discussion of three at least is necessary for passing.[1] The answers are first looked over by the teacher himself and one colleague, and are graded with one of six predicates, the fifth of which in descending order is "satisfactory," and the sixth "unsatisfactory."

The candidate is not admitted to the oral part of the examination unless in each of his papers he gains at least the mark "satisfactory." When the teachers have thus arrived at their decisions, the papers are stitched together into books and sent to the royal board, which distributes them among the censors for their inspection, much of which they make as they travel in the train from school to school, from one end of Sweden to the other. The final decision is not reached until censors and teachers sit together in conclave somewhat later.

The oral examination is wider in range than the written examination and embraces all the subjects taught in the later years of school life. The rektor or headmaster in each school arranges the candidates in groups of five or six in a room; and in these rooms they are kept throughout the examination, while the censor is sometimes in one room and sometimes in another, according to the subjects of the examination. Various arrangements emphasize the importance of the occasion. At least three persons of position, nominated by the inspecting local authority, represent the public. Evening dress is *de rigueur* for censors, examiners, and candidates; and the censors and the teachers wear their robes and decorations. The teacher of the candidates is generally the examiner; and, as a rule, puts all the questions under the direction and guidance of the censor. The examination, though apparently of the pupil alone, is really quite as much a test of the teacher, enabling the censor to judge of the efficiency of his work. It is also deemed useful for university professors to be brought for a few days in each year into such close touch with the pupils graduating from the public schools in the country, and for school and university thus to be brought into relationship. As in the case of the written, so also in the oral examination, each candidate is given one of six grades, of which the sixth is unsatisfactory.[1] It is so difficult for an ill-prepared candidate to be promoted to the highest class that the number of rejections at the final examination [2] is exceedingly small.

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[1] I quote freely from Mr. Thornton in what follows.

The aim of the realskola is to provide a common citizens' education of wider scope than that of the elementary school. The aim of the gymnasium is to add to general education imparted in the realskola a preparation for the universities or equivalent educational institutions. In 1912 the number of graduates from the realgymnasia was 675, and from the Latingymnasia 510. Of these 1,185 pupils, 160 continued their careers at business or commercial colleges, 144 entered on a military career, 111 went to higher technical schools, and 535 to universities, etc.

THE UNIVERSITIES.

There are two State universities in Sweden; one at Upsala, founded in 1477 and the oldest in Scandinavia, and the other at Lund, founded in 1668. Both of these are in provincial cities. There are, however, two privately organized universities, the Högskola at Stockholm and the Högskola at Goteborg (the second largest city in Sweden). Furthermore, the State supports a medical college, the Karolinska Institutet, at Stockholm, which it established in 1810.[3]

According to statutes of 1908 the direction of the State universities and medical college is exercised by a chancellor appointed by the Crown, without salary,[4] on the recommendation of certain authorities in these institutions. It is the duty of the chancellor to see that the statutes are observed, to issue instructions regarding the administration of the university finances and estates, to pronounce "finally and officially in questions of nomination, and, in general, in all university matters which are submitted to the decision of the Government. * * * The immediate management and supervision of all matters relating to the university is in the hands of its rektor, who is elected for a term of three years" (but is eligible for reelection) by certain university professors.

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[1] These grades are usually named *A* (mark of distinction), *a* (exceedingly satisfactory), *AB*, *Ba*, *B* (satisfactory), and *C* (unsatisfactory). The words in parentheses are doubtless Mr. Thornton's translations of the corresponding Swedish expressions given on p. 177.

[2] As a rule only about one-fourth of the pupils entering the gymnasia ever pass this examination.

[3] There are also two foreign universities founded in the seventeenth century under Swedish rule, namely, the universities at Helsingfors in Finland and at Dorpat in Russia.

[4] The chancellor is entitled to appoint a salaried secretary.

In 1913 there were about 5,200 students at the Swedish universities and medical college: 2,461 at Upsala, 1,421 at Lund, 395[1] at the Karolinska Institutet, 741 at the Stockholm Högskola, and 235 at the Goteborg Högskola.

The Högskola of Stockholm is under the superintendence of the chancellor of the universities. The governing body is a board of nine members, the president of which is nominated by the Government. The rektor of the university is an ex officio member of the board. Six other members are elected by the Swedish Academy, the Academy of Sciences, the Stockholm city council, and the faculty. The ninth member of the board is elected by the board itself.

It is under the direction of professors at the Stockholm Högskola that *Acta Mathematica* has been published.[2] This has been made possible by the annual grant of 3,000 kronor.

At each of the universities (except that at Goteborg) mathematics is taught in the faculty of philosophy; and in this faculty, till lately, three degrees were conferred—those of candiate, licentiate, and doctor. According to a statute of 1907, however, the examination for the first of these degrees was replaced, for those expecting to go into secondary school teaching, by a secondary school teachers' examination (*filosofisk ämbetsexamen*). All candidates for teaching positions in a gymnasium must have passed this examination. Should the candidate aspire to be a professor (lektor), he must also pass the second university examination (*filosofie licentiatexamen*), and defend a thesis for the degree of doctor (*filosofie doktor*). The first of these examinations requires about seven or eight semesters (that is, about four years) of study; the second, about four years more.

Filosofisk ämbetsexamen.—The faculty of philosophy is divided into two sections: The section of the humanities, and the mathematics-natural sciences section. To the latter section belong mathematics, astronomy, physics, mechanics, chemistry, geology and mineralogy, botany, and zoology. Since 1909 political economy may, under certain circumstances, be included in this section. Geography belongs to both sections. The filosofisk ämbetsexamen is is based upon the following groups of subjects:

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[1] In the State universities "every student is obliged to belong to one of the unions called *nationsföreningar*, or simply *nation*, or *landskap* (literally, province), into which the students are grouped, according to the part of the country from which they come, the object of these unions being to encourage hard study and pure morals, as well as the rendering of mutual aid. At Upsala there are 13 and at Lund 12 of these nation societies, each under control of an *inspector* chosen by the society from among the professors of the university. At Upsala these unions have as a rule their own club premises * * *; at Lund there is one clubhouse common to all the 'nations,' that of the Akademiska Foreningen. These unions have played an important rôle in the life of the students, both in its serious and its more convivial aspects. The distinctive feature of the students' dress is the white cap (*vita mössan*), known abroad from the tours of students' choral unions."

[2] The first number of its forty-first volume appeared recently.

Group 1. Northern languages, Latin.
Group 2. Northern languages, German.
Group 3. Northern languages, English.
Group 4. Northern languages, history.
Group 5. Latin, Greek.
Group 6. Latin, history.
Group 7. German, English.
Group 8. German, romance languages.
Group 9. English, romance languages.
Group 10. History, geography.
Group 11. Geography, botany, zoology.
Group 12. Mathematics, physics.
Group 13. Physics, chemistry.
Group 14. Chemistry, botany, zoology.

Application for the ämbetsexamen must be accompanied by—(1) a statement of the choice of subjects; (2) a certificate that the applicant has been a member of a nation society during the term in which the examination is to take place; (3) the certificate, showing that the candidate has passed the studentexamen; (4) the candidate's record book of university work (*tentamensbok*); (5) a fee of 15 kronor (about $4.09), plus 3 kronor for making out reports, plus 1 krona for janitor service.

As we shall be frequently referring to the grades which the candidate obtains in university examinations, it may be stated at once, that, as in the case of secondary school marking, they are six in number. If, for definiteness, we employ the letters that have been already mentioned, these grades are: *A*, with honor (*berömlig*); *a*, with exceptional praise (*med utmärkt beröm godkänd*); *AB*, with praise (*med beröm godkänd*); *Ba*, not without praise (*icke utan beröm godkänd*); *B*, satisfactory (*godkänd*); *C*, not satisfactory (*icke godkänd*).

To pass the examination we are considering, the candidate must obtain seven points. He has three points to his credit for each *A* which he receives in the subjects of the examination; two points for each *a* or *AB*; and one point for each *Ba* or *B*.

From this we see that mathematics and physics, the subjects of group 12, could contribute at most six points. But the candidate must also pass an examination in some third subject, as well as in psychology and the history and theory of pedagogy. In the case of group 12 the third subject may be any other subject in the mathematics-natural science section. Mathematics may be taken as a third subject with any two-subject group.

Whatever selection of group is made for the major, if it is a two-subject group, the candidate must obtain at least a mark *AB* in each; if it is a three-subject group at least a mark *AB* in two subjects and *B* in the third. Moreover, in the mathematics-natural science section six of the seven points must be obtained in subjects selected from the following list: Theoretical philosophy, literary history and poetics, German, English, romance languages, pedagogy, geography, mathematics, astronomy, physics, mechanics, chemistry, geology and mineralogy, botany, and zoology.

In the ämbetsexamen at the University of Lund the requirements in mathematics for several grades assigned are as follows: (1) For *B* the candidate must show that he has a good general knowledge of analytic geometry, elements of the differential calculus and of the most important parts of the integral calculus; (2) for *AB* the candidate must be familiar with the subject matter in (1), with differential calculus and its geometric applications, with an extensive and thorough course in algebraic analysis, with a good course in integral calculus, with the elementary theory of equations, with the foundations of theory of numbers and theory of probability, and with a short course in modern geometry, particularly the application of the theory of projection and reciprocation to conic sections; (3) for *A* the candidate must show remarkable facility in handling the material of (1) and (2), and also of some important course the content of which may be optional with the examinee to a considerable extent, but each particular choice must be approved by the examiner.

The examination in every subject is oral. The professor reports to the examiner his personal opinion of each candidate whom he has taught. He not only indicates the extent of work covered, but also expresses an opinion as to the thoroughness of the student's knowledge and as to the independence and maturity of judgment which he has manifested.

The titles of some courses offered at the university will be given later, and it will be seen that certain of these are formulated to prepare the student for the searching tests. Among the great number of books which are found useful by the mathematician in preparing for the *filosofisk ämbstsexamen* the following are officially listed at Lund:

K. R. COLLIN, *Lärobok i plan analytisk geometri.* 2 upplagan. Stockholm, 1898. (Rather brief.)[1]

BRIOT et BOUQUET, *Leçons de géométrie analytique.* 17e édition. Paris, 1900.

C. F. E. BJÖRLING, *Lärobok i differentialkalkyl och algebraisk analys.*[2] 3. upplagan. Lund, 1909.

C. F. E. BJÖRLING, *Lärobok i integralkalkyl.* Upsala, 1877.

SERRET-HARNACK, *Lehrbuch der Differential- und Integralrechnung.* Bearbeitet von Scheffers. 4. und 5. Auflage. Band I: Differentialrechnung. Leipzig, 1908. Band II: Integralrechnung. Leipzig, 1911.

W. NERNST und A. SCHÖNFLIES, *Einführung in die mathematische Behandlung der Naturwissenschaften. Kurzgefasstes Lehrbuch der Differential- und Integralrechnung mit besonderer Berücksichtigung der Chemie.* 7. Auflage. München und Berlin, 1913.

TODHUNTER, *Theory of Equations.* 4th edition. London, 1880.

WEBER und WELLSTEIN, *Encyklopädie der Elementar-Mathematik.* Band 1: Algebra und Analysis. 3. Auflage, Leipzig, 1909; Band 2: Elemente der Geometrie. 2. Auflage. Leipzig, 1907; Band 3: Angewandte Elementar Mathematik. 2. Auflage. 2. Teilen. Leipzig, 1910–1912.

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[1] This comment and others of a similar nature which follow occur in the original list.

[2] In this work, applications to plane geometry are considerably more extensive than is usual in books of a similar nature.

TODHUNTER, *Algebra for the use of schools and colleges with numerous examples.* 5th edition. London, 1871. (For theory of numbers and theory of probabilities.)

C. F. E. **BJÖRLING,** *Lärobok i nyare plan geometri.*[1] Lund, 1896.

The requirements in mechanics and mathematical physics,[2] in the filosofisk ämbetsexamen at the University of Lund, for various marks are: (1) For the mark *B*, the candidate must know the elements of the kinematics and statics of rigid bodies, including computation of stability, the elements of dynamics of a particle (also relative motion), the elements of the dynamics of solid bodies moving in a plane, and central impulse with friction, and must have the ability to solve simpler problems within the limits of the course in a *reliable* manner; (2) for the mark *AB* the candidate must be familiar with the subject matter in (1), with discussion of statics of a flexible string, with more extended development of rigid dynamics, including Lagrange's equations of motion and the elements of the theory of the motion of a rigid body about a fixed point, with hydrostatics, with differential equations of hydrodynamics and Bernoulli's theorem, with the theory of small vibrations applied to organ pipes and strings, and with attraction between spheres, and he must also have facility in the solution of problems within the range of the course; (3) for the mark *A* the candidate must complete the course in (2) with respect to general dynamics and by means of a detailed study of some field in mathematical physics or in mechanics of continuous media, chosen by the candidate in consultation with the examiner. He must also have skill in applying practically the theoretical knowledge appertaining to the courses.

Prerequisites in mathematics.—For a *B* in mechanics it is necessary to know what corresponds to the requirement for *B* in mathematics. For an *AB*, in addition to the requirements in analysis for the same predicate in mathematics, the candidate must have some notion of ordinary differential equations and the most elementary ideas of partial differential equations. For the mark *A* there may be required in addition to ordinary and partial differential equations important branches in one part or another of mathematical analysis.

Studies and textbooks.—The studies are appropriately begun in the free preliminary course (for *B*) as prescribed every spring term in connection with practical exercises. In order to obtain any advantage from this it is, however, necessary at the same time to work at home, partly by carefully reviewing the notes taken at every lecture and carrying on collateral reading in appropriate textbooks, and partly by diligently solving problems in addition to the one which has been taken up in the practical exercises.

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[1] The principal parts of this work include a treatment of the theory of conics from projective and dualistic points of view, in addition to a presentation of the theory of invariants in linear substitutions for binary and ternary forms, and, finally, after a section on "Curves of higher order" where among other results the Plückerian formulæ are derived, a treatment of the theory of cubic curves. Other works, not mentioned above but widely used in Sweden, are: L. Kiepert, *Grundriss der Differential- und Integralrechnung,* umgearbeitet von M. Stegemann. 2 Bände. Band I, 10. Auflage. Hannover, 1905; Band II, 9. Auflage, 1908. De la Vallée-Poussin, *Cours d'analyse infinitésimal.* 2 tomes. 3. et 2. éditions. Louvain, 1912 and 1914. Goursat, *Cours d'analyse mathématique.* 3 tomes, tomes 1–2. 2. édition. Paris, 1910–15.

[2] Studiehandbok, p. 168–173; astronomy and physics are treated on pp. 160–167.

At the conclusion of the preliminary course similar regularly recurring lectures and exercises for the next higher certificate can be taken up. (To profit by these the home work should be somewhat of the same nature as that in connection with the preliminary course.)

Really satisfactory textbooks for beginners are not readily found at present. For the time being, however, the most suitable work which can be recommended is Lindskog's *Lärobok i mekanik*, Stockholm, 1894, which also contains practical problems. Chapters 13 and 17 may be omitted, and for the certificate *B* also paragraphs 140–142, 155–159, 167–168.

For the certificate *AB* a more thorough knowledge of Lindskog's mechanics is required. It is not expedient to recommend a definite textbook for this certificate, because a few of this kind which are worthy of notice are just now being published or revised. The following may be mentioned first:

P. APPELL et S. DAUTHEVILLE, *Précis de mécanique rationelle*. Paris, 1910.
A. G. WEBSTER, *The Dynamics of Particles, and of Rigid, Elastic, and Fluid Bodies*. Leipzig, 1904. (Out of print, but a German as well as a new English edition is being prepared.)[1]

The first-named book, which contains also a collection of practical problems, corresponds most nearly to the prescribed course. Still, parts of chapters 14, 16, and 18 can be omitted. The latter book contains comparatively more of the mechanics of fluids and of elastic bodies and is specially to be recommended to those who intend to devote themselves to physics.

Among problem collections we may mention:

H. L. DE ST. GERMAIN, *Recueil d'exercices sur la mécanique rationelle*. 2. édition. Paris, 1889.
A. FUHRMANN, *Aufgaben aus der analytischen Mechanik*. 2 Bände. Leipzig Band I, 3. Auflage, 1904; Band II, 2. Auflage, 1882.
W. WALTON, *A collection of problems in theoretical mechanics*. 3. edition. Cambridge, 1876.
———, *A collection of problems in hydrostatics and hydrodynamics*. Cambridge, 1847.
M. JULLIEN, *Problèmes de mécanique rationelle disposés pour servir d'applications aux principes enseignés dans les cours*. 2. edition. 2 vols. Paris, 1866–67.
K. W. F. KRAFT, *Sammlung von Problemen der analytischen Mechanik*. 2 Bände. Stuttgart, 1884–85.

Filosofie licentiatexamen.—Those who have passed the filosofisk ämbetsexamen are eligible for the filosofie licentiatexamen. In each examination subject the candidate must make *AB* at least. An acceptable scientific thesis must also be written.

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[1] The second English edition was published in 1912, shortly after this was written.

Application for the examination must be accompanied by—(1) a statement of the choice of subjects; (2) a certificate that the applicant has been a member of a nation society during the term in which the examination is to take place; (3) the certificate showing that the candidate has passed the filosofisk ämbetsexamen; (4) the candidate's record book of university work (tentamensbok); (5) a fee of 15 kronor (about $4.09), plus 3 kronor for making out reports, plus 1 krona for janitor service.

The present regulations governing the licentiatexamen went into effect in 1911. They provide that every student who has passed either that examination or the filosofisk ämbetsexamen has the right to ask for an examination in supplementary subjects, for the sake of obtaining higher reports. No one may take more than one supplementary examination. The standing in supplementary examination carries with it the same rights as in other subjects. The fee for this examination is 5 kronor for each subject, plus 3 kronor for making out reports, plus 1 krona for janitor service.

The licentiatexamen calls for insight into the more fundamental parts of modern higher mathematics. The higher certificates require an exceptional scientific thesis based upon special studies appropriately chosen. There is considerable latitude in making the choice. But "however the subjects are arranged," the announcement concerning the examination reads, "one must neither thrust to one side modern insistence on logical exactness nor neglect geometrical intuitive methods."

In preparation for the filosofie licentiatexamen in mathematics, the lectures in higher mathematics delivered by professors or assistants are intended either to illuminate such parts of broad fields as are little available on account of gaps in texts, etc., or else to orient the student in some special topic. The seminary exercises have the same end in view.

Among the texts which are useful in preparing for this examination in the most fundamental fields the following are mentioned in the Studiehandbok of the University of Lund:

É. PICARD, *Traité d'analyse*. 2. édition. 3 tomes. Paris, 1901–1909.

W. F. OSGOOD, *Lehrbuch der Funktionentheorie*. Band I. 2. Auflage. Leipzig, 1912. (More complete in some respects than Picard.)

N. NIELSEN, *Laerebog i elementaer Funktionsteori*. København, 1909.

H. DURÈGE, *Elemente der Theorie der Funktionen einer komplexen veränderlichen Grösse*. 5. Auflage bearbeitet von Maurer. Leipzig, 1906.

Can be used with advantage for an introductory course.

C. JORDAN, *Cours d'analyse de l'École Polytechnique*. 3. édition. 3 tomes. Paris, 1909–1915.

Separate sections on elliptic functions and also introductory chapters on partial differential equations.

C. A. A. BRIOT et J. C. BOUQUET, *Théorie des fonctions élliptiques*. 2. édition. Paris, 1875.

In many respects now antiquated, but can still be used with profit.

L. SCHLESINGER, *Einführung in die Theorie der Differentialgleichungen*. 2. Auflage. (Sammlung Schubert.) Leipzig, 1904.

K. HENSEL und G. LANDSBERG, *Theorie der algebraischen Funktionen einer Variablen und ihre Anwendung auf algebraische Kurven und Abelsche Integrale*. Leipzig, 1902.

C. F. E. BJÖRLING, *Lärobok i nyare plan geometri* (och algebra). Lund, 1896.

G. SALMON, *Traité de géométrie analytique: courbes plans*. 3 édition par O. Chemin. Paris, 1903.

H. WEBER, *Lehrbuch der Algebra*. 2. Auflage. 3 Bände. (Band III: Elliptische Funktionen und algebraische Zahlen.) Braunschweig, 1898–1908.

E. NETTO, *Substitutionentheorie und ihre Anwendung auf die Algebra*. Leipzig, 1882.

J. P. C. PETERSEN, *De algebraiske Ligninger's Theori*. København, 1877. (For an introduction to the subject.)

J. TANNERY, *Introduction a l'étude de la théorie des nombres et de l'algèbre supérieure*. Conferences rédigées par E. Borel et J. Drach. Paris, 1895.

For an introduction to the subject.

F. KLEIN, *Vorlesungen über das Ikosaëder und die Auflösung der Gleichungen vom fünften Grade*. Leipzig, 1884.

SCHEIBNER, *Beiträge zur Theorie der linearen Transformationen als Einleitung in die algebraische Invariantentheorie*. Leipzig, 1908.

G. SCHEFFERS, *Anwendung der Differential- und Integralrechung auf Geometrie*. Band II: Einführung in die Theorie der Flächen. 2. Auflage. Leipzig, 1913.

P. BACHMANN, *Grundlehren der neuern Zahlentheorie* (Sammlung Schubert). Leipzig, 1907.

A. R. FORSYTH, *Treatise on differential equations*. 4. edition.[1] London, 1914.

Contains a great number of useful examples, but is not satisfactory from a theoretical point of view.

SERRET-HARNACK, *Lehrbuch der Differential- und Integralrechnung*. Band III: Differentialgleichungen und Variationsrechnung. 3. Auflage. Bearbeitet von G. Scheffers. Leipzig, 1909.

G. Bohlmann and E. Zermelo were the editors of the second German edition in 1904.

The statements of the University of Lund concerning the filosofie licentiatexamen in mechanics are as follows:

To obtain the mark *B*, the requirements are the same as for the highest certificate in the filosofisk ämbetsexamen in mechanics.

To obtain the mark *AB*, the candidate must (*a*) have prepared himself in a complete course in general dynamics and mechanics of a rigid body in conformity with the requirements for the highest certificate in the filosofisk ämbetsexamen; (*b*) have some acquaintance with the most important branches of mathematical physics and of the mechanics of continuous media; (*c*) have a thorough grasp of at least one of the sciences (for example, hydrodynamics, or theory of elasticity or thermodynamics, etc.), together with a detailed study of the modern literature connected with the science in question.

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[1] The second edition by W. Jacobsthal of H. Maser's German translation (with the solutions of the problems) of the third English edition of Forsyth's work was published at Leipzig in 1912.

To obtain the mark *A*, the candidate must not only meet the requirements just indicated, but must also prepare a piece of research work of actual scientific value.

The person who intends to devote himself specially to mechanics or mathematical physics is advised to direct his studies for the ämbetsexamen in such a way as to enable him to obtain two certificates in physics and the highest certificate in mathematics. In the latter subject the main emphasis should be on analysis, such as ordinary and partial differential equations, calculus of variations, general theory of functions, elliptic functions, together with spherical harmonics and Bessel's functions.

Literature list.—The literature list given below lays no claim to completeness, and the entries are chiefly of works suitable as text-books. Among books in one and the same subject those stand last which on account of size or character are better suited to profound study in the special subject. Short or popular texts come first.

H. WEBER, *Die partiellen Differentialgleichungen der mathematischen Physik.* 2 Bände. 5. Auflage. Braunschweig, 1910–1912.

A. WANGERIN, *Theorie des Potentials und der Kugelfunktionen.* (Sammlung Schubert.) Band I. Leipzig, 1909.

A. GRAY and G. B. MATHEWS, *A Treatise on Bessel functions.* London, 1895.

CHRISTIANSEN-MÜLLER, *Elemente der theoretischen Physik.*[1] 3. Auflage. Leipzig, 1910.

P. APPELL, *Traité de mécanique rationelle.* Tomes 1–2, 3. édition. Paris, 1909–1911; tome 3, 2. édition, Paris, 1908.

The first volume may be dispensed with, since it has been already read for the certificate in the ämbetsexamen. The third volume contains the theory of potential, hydromechanics, and theory of elasticity.

E. MACH, *Die Mechanik in ihrer Entwicklung historisch-kritisch dargestellt.*[2] 7. Auflage. Leipzig, 1912.

Critical presentation of the foundations of mechanics. Recommended even for the highest certificates in the ämbetsexamen.

G. R. KIRCHOFF, *Vorlesungen über mathematische Physik.* Band 1: Mechanik. 4. Auflage von W. Wien. Leipzig, 1897.

Succinct presentation—especially from the mathematical standpoint—of the whole of mechanics.

W. THOMSON and P. G. TAIT, *Treatise on Natural Philosophy.* New edition, 2 volumes. Cambridge, 1903.

A masterly presentation of mechanics from the physicist's standpoint, but unsystematic and for that reason unsuitable as a text. In part perhaps somewhat out of date, but none the less readable. Complements Appell and Kirchoff in valuable manner.

E. J. ROUTH, *Treatise on the Dynamics of a System of Rigid Bodies.* 2 volumes. Volume 1: The elementary part, seventh edition, London, 1905. Volume 2: The advanced part, sixth edition, London, 1905.

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[1] English translation of the first edition by W. F. Magie. London, 1897.

[2] English translation from the second German edition by T. J. McCormack, Chicago, 1893. 2d edition, revised, 1902. Supplement by P. E. B. Jourdain, Chicago, 1915.

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P. DRUDE, *Lehrbuch der Optik.* 3. Auflage von E. Gehrcke. Leipzig, 1912.

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Doctorate.—In order to procure the degree of doctor of philosophy the candidate must have passed the filosofie licentiatexamen, and have published and publicly defended an original scientific thesis on a subject connected with the studies in which he has received commendation in the licentiatexamen. The thesis and defense or disputation must be satisfactory to the faculty.

The members of the mathematics-natural science faculty are supposed to be present at the disputation, in which a representative of the faculty and two supporters of the candidate take part. The regulations seem to imply that such functions are not always of an amiable character: "The dean, or some other professor whom he may appoint, shall see to it that order and decorum are preserved. In case disorder or disturbance arises and can not be quelled by pleasant means by him or his deputy, he has the right to dismiss the assembly. Whatever he requires must be immediately observed by all present." The paragraph then concludes, "After the disputation has lasted four hours the dean, or his deputy, may conclude the same if he is so inclined."

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[1] English translation of the second revised edition, by R. N. Baynes. London, 1899.

Courses.—In 1891 regulations as to the nature and method of instruction in Swedish universities were formulated. They provided that all instruction given with a view to preparing for examinations must be so arranged that "scientific lectures in each examination subject shall be given each year, and that exercise courses, partly introductory courses, and partly seminary courses shall be furnished." They provided also that "one course within the purview of the faculty instruction should conclude with an oral or other examination suitable for those electing the course."

Consequently, as far as the number of instructors will allow, an endeavor is made to provide annually the essential requirements for the predicate *AB* in the filosofisk ämbetsexamen, and in addition at least the especially fundamental parts of analytic geometry and calculus, which properly belong to a propaedeutic course. In special exercises, on which great stress is laid, an attempt is made to have the students acquire the habit of solving with facility harder problems, such as are generally treated in the courses. In Lund these courses and exercises are compulsory to a certain extent; in Upsala, requirements of this kind have not yet been introduced in connection with mathematics.

The public lectures aim to give, on the one hand, broad general presentations of fields which properly belong to examination courses; on the other hand a thorough discussion of special questions. In the seminary exercises analysis of memoirs and report and discussion of original papers encourage the development of independent scientific work.

The following courses in astronomy, pure mathematics, and mechanics were offered at the University of Lund during the four semesters (which are now referred to here as first, second, third, and fourth), from the autumn semester, 1914, to the spring semester, 1916, inclusive:

During the first semester Prof. C. V. L. Charlier lectured on "Motions of star clusters"; during the second on "Multiple correlation" and "Use of the kinetic theory of gas in the motion of star clusters," three hours a week; during the third on "Selected parts of the theory of enumerating the stars"; and during the fourth for three hours a week on "Selected parts of star statistics." In each of the semesters Charlier and an assistant conducted a seminary in astronomy for those aspiring to the marks *B*, *AB*, or higher in the filosofisk ämbetsexamen.

T. Brodén, professor of mathematics, conducted: (*a*) In the first semester—(i) a preliminary course with the aid of an assistant; (ii) a course of about 20 lectures on the theory of functions; (iii) an elementary course of about 10 lectures on infinite series; (iv) an elementary seminary course, two hours every fortnight. (*b*) Second semester—(i) a preliminary course; (ii) a course on selected topics of the ämbetsexamen; (iii) a course on theory of functions (about 30 lectures); (iv) a course on some phase of the modern theory of aggregates; (v) an elementary seminary course. (*c*)

Third semester—(i) a course in theory of equations, a preliminary course in calculus, selected topics in theory of conics and certain arithmetic applications of higher analysis, three hours a week; (ii) an advanced seminary course on the connection between analysis and the theory of numbers, one hour. (*d*) Fourth semester—(i) preliminary course; (ii) elementary course in algebraic analysis and arithmetic applications of higher analysis, two hours; (iii) advanced seminary exercises, one hour.

V. W. Ekman, professor of physics: First semester—(i) mechanics, two hours a week for two certificates in the ämbetsexamen; (ii) hydrodynamics, one hour; (iii) exercises in mechanics, one hour. Second semester—(i) mechanics (first course), three hours; (ii) motion of liquids and theory of friction, one hour; (iii) exercises in mechanics, one hour. Third semester—(i) mechanics (continuation course and course for two reports in ämbetsexamen); (ii) theory of elasticity, one hour; (iii) exercises in mechanics, one hour. Fourth semester—(i) preliminary course in mechanics, two hours; (ii) theory of elasticity, one hour; (iii) exercises in mechanics, one hour.

N. E. Nörlund, professor of mathematics: First semester—(i) elliptic and automorphic functions, three hours; (ii) advanced mathematical seminary, one hour. Second semester—(i) elliptic and automorphic functions, one hour; (ii) theory of numbers, one hour; (iii) advanced mathematical seminary, one hour. Third semester—automorphic functions and higher algebra, three hours; (ii) elementary mathematical seminary, one hour. Fourth semester—(i) higher algebra, three hours; (ii) elementary mathematical seminary, one hour.

F. A. Engström, astronomical observer: All four semesters—(i) use of simpler astronomical instruments for determination of the time and of latitude, one hour; (ii) exercises in astronomical observations.

H. G. Block, docent in astronomy: First, second, and third semesters—in each, celestial mechanics, 15 lectures.

N. G. O. Kuylenstierna, docent in mathematics: First semester—on Laplace's equation, 15 lectures. Second semester—integral equations, 20 hours. Third semester—selected chapters in the theory of linear differential equations, 15 lectures.

K. A. W. Gyllenberg, docent in astronomy: Third semester—(i) spherical astronomy, for meeting requirements for *AB* in filosofisk ämbetsexamen; (ii) general astronomy and the stars (requirements for *B* in same examination). Fourth semester—(i) determination of orbits of comets, 3 hours; (ii) spherical astronomy (for *AB* in ämbetsexamen), 20 hours.

S. D. Wicksell, docent in mathematical statistics: Third semester—elementary principles of mathematical statistics, 25 hours. Fourth semester—theory of correlation, 25 hours.

At the University of Upsala in the spring term of 1916 courses in the following subjects were offered: Linear differential equations, theory of functions, differential equations, trigonometric series, theory of electricity, rational mechanics, integral equations, and theoretical astronomy.

SECONDARY-SCHOOL TEACHERS.

There has been given above an outline of the work that a mathematical teacher must do in the State secondary schools, and of work in school and university which he must have completed by way of preparation. But Sweden requires still more, namely, a year of probation (*provår*). This year of professional training is taken at one of the seven schools officially prescribed for this purpose, three of which are located at Stockholm, one at Upsala, one at Lund, and two at Goteborg. The number of "candidates" is about 70 a year.

Having finished his university course in the spring,[1] and having decided to become a teacher in secondary schools, the candidate sends to the royal board of secondary schools copies of his final examination certificate and of his various university certificates, naming at the same time the three subjects he wishes to be trained in, which are, say, mathematics, physics, and chemistry. In the autumn he is assigned to some one of the schools along with perhaps nine others. After he has had an interview with the head master or rektor, there are assigned to him from the members of the staff, various supervisors or directors, under whose particular direction he remains during his training. A man may have one supervisor given him for mathematics in the lower classes, another for mathematics in the higher, and a third for physics and chemistry. The first two or three weeks may be spent in watching the work of the classes (the lowest for the most part) and listening to the instruction given. Then comes a little teaching, first in the presence of the teacher and then in his absence. After that comes the first "criticism lesson"[2] given, perhaps, to the lowest class, in the presence of the rektor and the teacher of the class and the rest of the students in training. As soon as possible after the termination of the lesson all those who thus witnessed it meet with the candidate and discuss its matter and manner. And so in the second, third, and fourth classes there might be listening and teaching and a second "criticism lesson." In the fifth class there is possibly continuous teaching for a month, both with and without the teacher; then "criticism lessons" follow; and the first term closes with the class leaving the realskola for the gymnasium.

In the spring term the candidate watches the teaching of algebra and geometry in Ring I, going through his first "criticism lesson" in those subjects in Ring II. He may have a criticism lesson in Ring III in trigonometry and solid geometry, and in Rings II–IV, he may have criticism lessons in physics and chemistry, or he may give a month of continuous instruction in one of these subjects followed by a criticism lesson. In addition, he is expected to take class teaching if one of his supervisors is kept away on account of illness.

Besides all this, an elaborate series of lectures is given to the candidates on the theory and history of education and pedagogy. Lectures are also given on method in connection with special subjects.

The rektor, having heard the criticism lessons and received periodical reports both from the candidate and his supervisors, holds a *scrutinium*, attended by those of his colleagues who have taken part in the training; and the precise character of the certificate to be given the candidate is then settled by discussion and by full interchange of opinion and evidence. This certificate becomes an important asset in the teacher's stock in trade, one upon which the character of his first employment largely depends. A sample follows:

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[1] From Mr. Thornton's report.

[2] A "criticism lesson" is a lesson specially prepared for criticism on the part of his fellow candidates and of his teachers.

TRAINING CERTIFICATE.

X Y Z, *Licentiate in Philosophy,*

who in autumn *term 1893 and* spring *term 1894 according to the regulations in force has undergone a training course at the Elementarläroverk in this place, has displayed*

in the theoretical course:

an exceedingly satisfactory[1] *knowledge of the theory and history of education;*

in the practical course:

In Mathematics (Class I, III, V, VI 2, VII, 1)[2] a distinguished[3] *capacity for teaching.*

In Physics (Class VI and VII 1) an exceedingly satisfactory *capacity for teaching.*

In Chemistry (Class VI and VII 1) an exceedingly satisfactory *capacity for teaching.*

In .... (Class ....).

and there has therefore been awarded to him, as a public testimony to his capacity for teaching, the certificate "exceedingly satisfactory." *He has besides shown* distinguished *industry and* exceptional *aptitude for the teacher's calling.*

Upsala, the 2d of June, *1894.*

(Signed) A. B.,
Principal in the
practical course.

(Signed) C. D.,
Principal in the
theoretical course.

The teaching staff of a gymnasium consists of the rektor or head master and three ranks of permanent teachers: (*a*) Professors (*lektorer*) who teach chiefly in the upper classes of the higher schools and who must be doctors; (*b*) assistant professors (*adjunkter*), who teach in realskolor, in lower classes of large gymnasia, and in the smaller gymnasia, and who, as far as the university is concerned, need only to have passed the filosofisk ämbetsexamen;[4] and (*c*) instructors (*övningslärare*) teaching drawing, music, gymnastics, and the use of arms.

According to the official regulations the applicant for a position as a lektor or adjunkt on the staff of a State secondary school must—

(1) Be 23 years old, at least.

(2) Be in good health and not crippled in such a way as to be unable to get about.

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[1] That is, *a*.

[2] These Classes VI 1, 2, and VII 1, 2, are now known as Rings I, II, and Rings III, IV.

[3] That is, *A*.

[4] The prospective adjunkt of mathematics who has passed this examination may have taken mathematics as a third subject with one of the groups in the humanities.

(3) Be known for honor and probity, and in case the chair includes instruction in religious matters, must confess belief in the true evangelical faith.
(4) Be conspicuous for sincerity and strength of character, and for the good temper necessary in the guidance of youth.
(5) Be endowed with ability easily and clearly to impart instruction.
(6) Be thoroughly conversant with the subjects connected with the chair he seeks.
(7) Be prepared by a year of professional training.
(8) Have performed, with industry and skill, for a period of not less than two years, the duties which devolve upon a lektor or adjunkt in (*a*) a boys' high school; or (*b*) some institution of learning under the jurisdiction of the royal board; or (*c*) a training seminary for elementary schools; or (*d*) a technical elementary school; or (*e*) the royal naval academy; or (*f*) a high school supported by the State. Or have served as *docent* in a university for not less than two years, in such a manner as would entitle him to an honorarium.

The prospective lektor must also (*a*) have obtained *AB* or higher in all those subjects of the åmbetsexamen which correspond to subjects in which the chair has been announced as vacant; (*b*) have passed the licentiatexamen with the grade *AB* or higher in one of those subjects; (*c*) have satisfied the requirements for the doctorate. The lektor who teaches mathematics must also be conversant with the mechanics and astronomy in the course for the licentiate.

In the larger gymnasia the rektorer are required to teach from 12 to 16 hours a week, in the smaller from 20 to 24; the professors from 18 to 22; and the assistant professors from 20 to 28 hours a week. A rektor at a realskola is obliged to teach from 18 to 20 hours weekly.

An adjunkt begins with a salary of 3,000 kronor (about $818) which may be increased 500 kronor every five years until the maximum salary of 5,000 kronor is reached. In Stockholm, Goteborg, and Norrköping schools the municipality also makes a grant toward rent of apartments. The salaries of lektorer range from 4,000 to 6,000 kronor. There are two scales of salaries for the rektor; namely, 6,000 kronor in the higher schools, with an increase of 500 kronor after 10 years, and 5,000 kronor in the realskolor with like increase after 10 years. In addition to this, rektorer have free lodging or an equivalent allowance.

All teachers are obliged to contribute an annual quota (maximum, 200 kronor) to their future pension. On attaining the age of 65 and after 35 years of service, teachers on the permanent staff are entitled to a pension—4,000 kronor (about $1,090.80) for lektorer and 3,400 for adjunkter. The rektor receives his pension (5,000 kronor in the gymnasia, 4,000 kronor in the realskolor), provided he has held the post of rektor for at least 15 years. The widow and children of a teacher on the permanent staff receive a considerable pension from a State-aided and State-controlled Widows' and Orphans' Pension Fund.

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"The Educational System in Sweden." Report of the Commissioner of Education for 1903–4. Washington, 1906. vol. 1, pp. 767–797.

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N. G. W. LAGERSTET, "Current Educational Movements in Sweden." Report of the Commissioner of Education for 1912–13. Washington, 1914. vol. 1, pp. 763–772.

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[1] That is, autumn term—from Sept. 1 to Dec. 16.

[2] That is, spring term—from Jan. 15 to June 1.

XVII. SWITZERLAND.

Switzerland is a confederation of 25 Cantons. It has a total area of less than 16,000 square miles and a population of about 3,900,000. The Cantons vary greatly in size; for example, Bern (Berne), Graubünden (Grisons), Valais (Wallis) are each over 2,000 square miles in extent, while the area of the Canton of Zug (Zoug) is less than 100 square miles.[1] German is spoken by the majority of the inhabitants in 19 of the Cantons, French in 5, and Italian in 1. About two-thirds of the total population speak German; about 800,000, French; and about 300,000, Italian.

There is no centralization of control in educational matters. Each Canton is almost completely autonomous in the arrangement of its school system, and while there are many similar features in the organization, the ideals are often widely divergent. But it is certainly true that in no country is the importance of training for the primary school teacher more clearly recognized than in Switzerland. There are no fewer than 4 State or private training colleges for such teachers in this little Republic.

SECONDARY SCHOOLS.

The secondary schools leading to higher studies have different names in the different Cantons: *Collège*, *gymnase*, *Oberrealschule*, *Kantonschule*. This last is the most common in the German Cantons.

Examined from the point of view of their external organization, these establishments present many notable differences. We generally find two *cycles*. The first cycle is of three or four years and forms the collège or gymnase inférieur; the second cycle comprises from four to four and one-half years. Pupils enter this latter cycle at the age of 14 or 15 years.

A gymnasium may be divided into two, three, or even four sections, according to the foreign languages taught. The two main sections common to all the gymnasia are: (*a*) The *classical* section, which leads to all the university faculties (and to the Federal Polytechnic School after special preparation in mathematics), the special studies being Latin, Greek, and philosophy; (*b*) the *technical or industrial* section, which leads more particularly to scientific, technical, or industrial careers. The students who go out from this section are admitted directly to the faculties of science and of letters, to the technical faculty at Lausanne, and to the Federal Polytechnic School. The gymnasium at Geneva possesses two other sections: (*c*) The *Real* section, in which Latin is taught in addition to modern languages. (It corresponds almost exactly to the section Latin-sciences in France or to the Realgymnasium in Germany, and its certificates of graduation admit to university faculties.) (*d*) The *pedagogic* section, which prepares candidates for teaching in the primary school and which also leads to the faculties of science and letters.

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[1] Although Bern is not the largest Canton, its population of about 665,000 is the greatest. The Canton of Zurich, with an area of some 670 square miles, ranks next, with a population of about 540,000.

Although secondary schools are under cantonal or municipal direction, there is in their programs a certain necessary common minimum brought about by Federal influence in connection with requirement for *examens fédéraux de maturité pour les candidats aux professions médicales*. The requirements in mathematics for this examination are as follows: (*a*) *Algebra.*—Equations of the first and the second degree in one and several unknowns; logarithms; arithmetic and geometric progressions; compound interest and annuities; permutations and combinations; probabilities; binomial theorem with integral exponent. (*b*) *Geometry.*—Plane and solid geometry; plane trigonometry; facility in construction of geometric figures; analytic geometry of point, line, circle, and conic; application of the theory of graphic representation to simple analytic functions and elementary functions of physics and mechanics.

The mathematical requirements of secondary schools often exceed these. In the Oberrealschule of Basel, which is open to suitably prepared students who are 14 years of age, the scheme of courses is as follows:

Class I. Arithmetic and algebra to equations of the first degree in several unknowns (3 hours). Plane geometry and the beginning of solid geometry (3 hours). Geometric drawing (2 hours).

Class II. Algebra: Theory of indices, logarithms; equations of the second degree (3 hours). Solid geometry (2 hours). Geometric drawing (2 hours).

Class III. Algebra: Progressions; compound interest, annuities and applications to insurance; determinants (3 hours). Plane and spherical trigonometry (3 hours). Geometric drawing, with practical exercises (2 hours).

Class IV. Algebra: Binomial theorem; series; complex numbers; solution of equations of higher degree; transcendental equations (2 hours). Analytic geometry (2 hours). Descriptive geometry and geometric drawing (4 hours).

Class V (1 semester). Elements of differential calculus with simple applications to geometry and physics (3 hours). Analytic geometry of three dimensions (3 hours). Descriptive geometry and drafting (4 hours).

At the end of the gymnasium course a certificate of maturity is awarded to those who pass written and oral examinations on the studies of the previous year or two years. The examiner is the teacher, but the examination is conducted under the supervision of one of the various forms of "commissions" to be found in the Cantons.

In nearly all the examination rules, it is noticeable that greater emphasis is laid on the display of intellectual maturity than on range of knowledge. The "maturity rules" of the gymnasium and Real school in Zurich state: "In mathematics and descriptive geometry the pupil shall indicate any new problems or applications which suggest themselves to him." At the Realschule in Zurich the oral examination is conducted in a manner similar to an ordinary class. The inspector makes a choice of three subjects proposed to him by the teacher. Some of the examination themes during the years 1907–1910 are as follows: Maclaurin's series; the equation $x = \tan x$; maxima and minima problems in optics; sketch of the applications of the idea of the derivative; Huygens's approximate construction for the rectification of a circle; problems on geographic and geocentric latitude; analytic treatment of problems from Steiner's paper "Ueber das Maximum and Minimum bei den Figuren;" curvature of conics; perspective of circular cones; construction of sun dials.

All schools unite in the opinion that the grade in the certificate of maturity shall not, in general, depend upon the examination but rather on the performance of the pupil in regular classroom work.

HOCHSCHULEN.[1]

Pupils with appropriate certificates of maturity may be regularly admitted to: (1) The *Eidgenössische Technische Hochschule* (Federal Polytechnic School) in Zurich; (2) a cantonal *École d'Ingénieurs* in Lausanne; (3) seven universities. In all of these training in advanced mathematical work is given.

(1) The *Polytechnic School*, which is the only Swiss scholastic institution under the direct supervision of the Federal authorities, is one of the greatest institutions of its kind in the world. It is organized into 11 sections, each with a course of 4 to 8 semesters. Most of the students turn to the engineering and chemistry sections. But somewhat over a score are in the section of mathematics and physics. The work of this section is supplemented by the general section, one part of which is known as the "Mathematisch-naturwissenschaftlich-technische Sektion."

Scheme of lectures in the mathematics and physics section during the first three semesters.

	Lectures.	Exercises.	Colloqium.
1. Semester (24 hours):	*Hours.*	*Hours.*	*Hours.*
Higher mathematics I	5	2	1
Analytic geometry	4	....	1
Descriptive geometry	4	4	1
Mathematical exercises	....	2	....
2. Semester (25 hours):			
Higher mathematics II	5	2	1
Applications of descriptive geometry	2	3	....
Mathematical exercises	....	2	....
Mechanics I	6	2	1
3. Semester (22 hours):			
Higher mathematics III	3	1	....
Geometry of position	3–4	....	....
Mathematical exercises	....	2	....
Mechanics II	4	2	1
Physics (heat)	4	....	1

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[1] *Cf.* note on p. 78.

Some of the topics in *Higher Mathematics II–III* are the following: Space curves, tangent, principal normal, and binormal, osculating plane; ordinary differential equations; equations of the first and higher order; linear equations of any order; systems of simultaneous linear differential equations; curvilinear integrals; Green's formula and harmonic functions; conformal representation; Fourier's series; elements of calculus of variations. In *analytic geometry*: Analytic treatment of projectivity, cylinders, and cones of revolution, general surface of second degree, focal conics, generation of ruled surfaces by projective pencils. In *geometry of position*: Projective forms of the first, second, third, and fourth species.

From the fourth to the eighth semester there is no fixed program of mathematical work, but the following courses are given periodically: Function theory, elliptic functions, algebraic equations, number theory, differential geometry, plane curves, algebraic surfaces. During the last two years, such instruction is supplemented by discussions in the mathematical seminary, and lectures on special topics such as: Quadratic forms, theory of definite integrals, theory of transformation groups, axioms of arithmetic and of geometry, line geometry. In applied mathematics the titles of some of the courses given in recent years are: Partial differential equations of physics, cylindrical and spherical harmonics and their applications in physics, electro-mechanics, thermodynamics, celestial mechanics, astrophysics, map making, theory of probabilities, mathematics of insurance.

To able students who have assiduously applied themselves to the work in a section a diploma is given after successful examination. The examination comprises three parts: (*a*) The *Vordiplomprüfung*, on subjects of the courses of the first three semesters; (*b*) the *Schlussdiplomprüfung*, on function theory, synthetic and analytic treatment of geometry, higher arithmetic and algebra, theoretic physics and astronomy; and (*c*) the *Diplomarbeit*, or thesis.

At the polytechnic school the mathematical student may proceed to the doctor's degree in the usual way. The standard for the thesis is high.

(2) *L'École d'Ingénieurs*, although part of the faculty of sciences of the University of Lausanne, has a certain measure of autonomy. The classwork (39–43 periods a week) of the first four semesters includes about the same amount of mathematics as in the first three semesters of the above-mentioned section in the Polytechnic. L'École gives diplomas in civil, mechanical, electrical, and chemical engineering.

(3) The *Swiss Universities* are situated at Basel, Zurich, Bern, Geneva, Lausanne, Fribourg, and Neuchatel. In the winter semester of 1913–14 Zurich and Bern had the largest teaching staffs and the largest number of students; Geneva came next.

At the university of *Basel* three types of lectures are given: (*a*) Introductory lectures, (*b*) course lectures, (*c*) special lectures. The introductory lectures consist of analytic geometry of the plane and of space (4 hours, 1 semester), and differential and integral calculus (5 hours, 2 semesters). These, and some supplementary lectures on algebraic analysis and descriptive geometry, are to prepare suitably for taking up course lectures[1] students who, though they may have the certificate of maturity, are not adequately prepared in mathematics. The course lectures treat of such subjects as algebra, function theory, elliptic functions, ordinary differential equations, partial differential equations, linear differential equations of mathematical physics, projective geometry, and theory of surfaces. The program of the special lectures is not fixed, but it includes lectures on elementary geometry and number theory on account of their application in school instruction, and on calculus of variations because of its significance in mathematical physics.

Attendance on course lectures, special lectures, participation in seminary exercises and the preparation of a suitable thesis lead to the doctorate in about eight semesters.

At the *University of Bern* there are also three classes of mathematical lectures: (*a*) Eight or nine hours a week during four semesters in preparation of candidates for positions as teachers in the higher primary schools, the so-called "Sekundar-schulen"; (*b*) 12 or 14 hours weekly during six semesters for future secondary school teachers and those who are specializing in mathematics; (*c*) "free lectures" on such topics as theory of hypergeometric series, selected chapters from the theory of differential equations, non-Euclidean geometry, calculus of variations, and method of least squares.

In the courses for teachers in the higher primary schools, practical geometry, plane and spherical trigonometry, descriptive geometry, analytic geometry, and calculus (2 hours, 2 semesters) are taken up.

The subjects for the mathematical specialist and secondary school teacher include: Definite integrals (6 semester hours), differential equations (4 semester hours), function theory (4 semester hours), theory of determinants (1 semester hour), analytic geometry of space (3 semester hours), theory of higher plane curves (3 semester hours), gamma functions (3 semester hours), and Fourier's series and integrals (three semester hours).

Examinations for secondary school teachers will be referred to later. The requirements leading to the doctorate are similar to those in the other universities.

At the *University of Geneva* the first two years may be spent in preparing for the baccalauréat ès sciences mathématiques, which is a sort of licence ès sciences. The examination for this consists of two parts, an oral and a written. The oral examination is on functions of a real variable, series, theory of equations, plane and solid analytic geometry, descriptive geometry and the elements of projective geometry, differential and integral calculus, mechanics, astronomy, physics, physical geography and meteorology, inorganic chemistry, and mineralogy. The written examinations cover all of the above-mentioned subjects except the last four.

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[1] Course lectures are often taken simultaneously with introductory lectures.

In 1908 the university established the *certificat d'aptitude à l'enseignement des sciences dans les établissements secondaires supérieurs.* A candidate for this certificate must (1) have the diploma of the "baccalauréat" from the university; (2) spend four semesters in further study at the university; and (3) finally show himself well versed in six academic studies. The examination consists of two parts, both of which may be taken at once. The first part of the examination is a thesis on a theme selected from the field of the major subject, and two trial lessons related to the minors. The second part consists of an oral examination in the three subjects chosen. The major and one minor are selected from the following: Infinitesimal analysis, algebra and higher geometry, mechanics, astronomy, physics, chemistry. The third subject, or second minor, is "the science of education," unless the candidate has the certificate of maturity from the pedagogic section of the gymnasium in Geneva, or an equivalent certificate, when philosophy or experimental psychology is substituted for the science of education.

In the oral examination some choice of subjects is possible. In *Infinitesimal Analysis* two of the following subjects may be selected: (*a*) Theory of analytic functions; (*b*) theory of elliptic functions; (*c*) differential equations; (*d*) partial differential equations of the first order; (*e*) calculus of variations; (*f*) introduction to mathematical physics (trigonometric series, Green's formula, etc.). In *Algebra and Higher Geometry* the examination covers: (*a*) Theory of equations, equations solved by square roots, applications in geometry; transcendence of e and π; (*b*) methods in geometry; (*c*) infinitesimal geometry, curves traced on surfaces, applicable surfaces, and (*d*) one of the following: (i) Theory of algebraic forms; linear transformations; invariants; geometrical applications; (ii) notions on the theory of substitution groups and its applications to the theory of equations; (iii) projective geometry; principal properties of conics and quadrics; study of some transformations; (iv) line geometry; ruled surfaces; congruences and complexes of lines. In *Mechanics* two of the following subjects may be selected: (*a*) General methods for integration of equations in mechanics; (*b*) kinematics and machinery; (*c*) hydrostatics and hydrodynamics; and (*d*) theory of elasticity. In *Astronomy* the examination is on practical astronomy and geodesy, and either spherical or theoretical astronomy.

Upon satisfaction of the usual requirements, the university also confers the degree doctorat ès sciences mathématiques.

At the *University of Lausanne* a student who has pursued certain courses for four semesters may present himself as a candidate for the Licence ès sciences mathématiques pures. The examinations for this degree are oral, written, and practical. The oral covers differential and integral calculus; theory of analytic functions; elliptic functions; analytic geometry; descriptive geometry; geometry of position; rational mechanics; applied mechanics; astronomy; mathematical physics; and selected chapters from analysis, geometry, and analytic mechanics.

The written examination consists of three tests in analysis, geometry, and mechanics. The practical examination is a geometric drawing (épure).

The Licence ès sciences physiques et mathématiques is given under similar conditions. At the University of Lausanne the degree of doctorat ès sciences is also conferred.

I have already referred to the "école d'ingénieurs" connected with this university.

According to the organization of the *University of Fribourg*, the diploma Licence ès sciences mathématiques is awarded to students who have attended and have taken part in the practical exercises of a Hochschule, for not less than eight semesters (two at least at Fribourg), and have passed successful examinations in four subjects: (*a*) Differential and integral calculus, including the theory of definite integrals, of differential equations, and of differential geometry; and (*b*) analytic and synthetic geometry. The other two subjects can be chosen from c_1) function theory and d_1) higher algebra, or c_2) experimental physics and analytic mechanics, or c_3) experimental physics and mathematical physics.

The degree doctor philosophiae naturalis is also conferred at Fribourg.

SECONDARY SCHOOL TEACHERS.

For secondary school teachers in Switzerland there are no fixed examinations similar to those for teachers in primary schools. Nor are there colleges for training such teachers, although, as we have seen, the University of Geneva has a pedagogic department. For most of the teaching positions in the secondary schools (Mittelschulen) the majority of the cantons demand that the candidate shall have completed a Hochschule course of four or five years. Such are the demands, for example, in the Canton of Fribourg where the *Licentiatsdiplôme* is necessary, and in the Canton of Geneva with its *certificat d'aptitude á l'enseignement des sciences dans les établissements secondaires supérieurs.* Those candidates with a record of but two years in a Hochschule can, usually, only be appointed as teachers in the lower classes of the better secondary schools. As an exception, however, according to a law of 1908 for the Canton Vaud, the licence certificate, which a candidate may secure after two years at the University of Lausanne, is the only necessary preparation for a teacher in the secondary schools. Students with a diploma from the École d'Ingénieurs with its two-year mathematical course are also in demand.

Several Cantons prefer that prospective teachers who have completed their studies shall have been engaged for several semesters as assistants in the Technische Hochschule; others prefer candidates who either before or after university studies have taught in one of the lower school grades. And still others have recently made some appointments to mathematical positions in Realschulen, of candidates holding engineering diplomas; not so much because of the lack of well-trained mathematical teachers as on account of the desire to emphasize, in the instruction, the applications of mathematics. But whatever the basis may be upon which the selection of secondary teachers is made, the standard is sure to be of a high order of its kind.

At this place further comment should be made with regard to work at the University of Bern. We have noted the six semester course for the oral and written *Patentprüfungen von Kandidaten des höheren Lehramts.* According to regulations of 1907–1911, the corresponding diploma entitles men to give instruction in the higher classes of the gymnasia. This diploma implies that the possessor has had, in addition to class instruction in mathematics and pedagogy, at least four weeks of practical experience in listening, or giving instruction to higher classes in the gymnasia.

For more than a decade past the *Verein Schweizerischer Mathematiklehrer* (*Société suisse des professeurs des mathématiques*) has been a source of inspiration to teachers through the opportunities which it offers both for social intercourse and exchange of ideas, and for methodic organization leading to advances in instruction of the science. The feeling is very general among members of this organization that the preparation of secondary school teachers should always include adequate professional training by means of courses in psychology and pedagogy at the university, for example, and by means of actual teaching in schools.

As to the remuneration of secondary school teachers, in the Canton of Zurich in 1900 the salaries ranged from about $780 to about $1,460. The head (rektor) of the secondary school is chosen from the staff. He serves for a period of three years and may be reelected. In Bern the ordinary teacher (25–31 hours a week) would receive about $750. Increases in salary, amounting to about $60 each are made at the end of 4, 8, and 12 years of service.

The range of pensions for secondary schools in Zurich, in 1893, was from $200 to $600 annually. More recent information is not available.

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XVIII. THE UNITED STATES.[1]

Like Germany and other federated States, the United States has no national system of education. It is, however, a notable fact that the educational systems in the 48 States and Commonwealths of the country are all constructed on the same general lines, and that the differences, although of local importance, are of a minor character when the systems are viewed as a whole.

In each State one finds that the pupil normally passes in order through: (1) The kindergarten, where the pupils are from 3 to 5 years of age;[2] (2) the elementary school, which has an eight-year course for pupils 6 to 13 years of age; (3) the secondary school or high school, with a four-year course for pupils of 14 to 17 years; (4) the college or institution of collegiate rank, for students from 18 to 21; and then on to (5) the university or institution of university rank.

The American secondary school, unlike similar schools in Europe, takes the pupils at 14, on the completion of an elementary course covering 8 years. This is due in part to the earlier establishment of elementary schools which aimed to give a general education extending in some cases to 9 or even 10 years. High schools are now very important establishments in the educational system of the country, and the increase in their number in recent years is enormous. In 1910–11 the number of "accredited secondary schools" in the United States was 12,213. In 1913–14 this number had increased to 13,714.[3] By an "accredited secondary school" is meant one—

> which is equipped to prepare students for colleges requiring at least 14 units[4] for unconditional admission and which has been investigated and approved for this purpose by one of the following agencies: A State officer of education, a university or college inspector or committee on admissions, or an officer or committee of an accrediting association.[5]

This standard imposes slight restrictions on the latitude of the program of study, so that it is quite impossible to indicate a program in any wise representative for even a large proportion of high schools in the country. But it may be worth while to give (1) a single program, and this of a well-known school founded over 270 years ago; and (2) illustrations of the variations of accrediting agencies.[1] These illustrations roughly indicate the relative importance in which subjects are regarded by large groups of schools.

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[1] As different phases of mathematical instruction and its problems in the United States have already received detailed treatment in reports of the International Commission on the Teaching of Mathematics published by the Bureau of Education, this sketch is added mainly for the sake of completeness. It is intended merely to emphasize some outstanding features and to give supplementary information.

[2] Here and in what follows I shall assume that the normal *lower* limits of age at the beginning of each year are considered.

[3] S. P. Capen, *Accredited Secondary Schools* (Bu. of Educ., Bul., 1916, No. 20). Washington, 1916, p. 7.

[4] "A unit represents a year's study in any subject in a secondary school, constituting approximately a quarter of a full year's work." This statement takes—(1) the four-year high-school course as a basis and assumes that (2) the length of the school year is from 36 to 40 weeks; that (3) a period is from 40 to 60 minutes in length; and that (4) the study is pursued four or five periods a week.

[5] S. P. Capen, *Accredited Secondary Schools* (Bu. of Educ., Bul., 1916, No 20), Washington, 1916, p. 7.

(1) The program selected is that (without Greek) of the Roxbury Latin school in 1915–16. The course of study there is designed to afford training for boys between the ages of about 12 and 18 and to qualify those who complete it to enter Harvard College, or other colleges or scientific schools, like the Institute of Technology.[2] The entering students are in the sixth class, those graduating in the first. The work covered in the fourth, third, second, and first classes is that which corresponds to the typical high-school course. The numbers in the different columns are class periods of 40 to 45 minutes.

Class periods in the Roxbury Latin School, 1915–16.

Subjects.	Sixth class.	Fifth class.	Fourth class.	Third class.	Second class.	First class.	Total.	Percentage.
English	190	152	152	114	76	114	798	13.7
Latin	190	190	190	228	190	190	1,178	20.3
French	....	190	190	152	152	190	874	15.0
German	....	....	....	190	190	190	570	9.8
History	....	....	114	114	114	....	342	5.9
Mythology	....	....	38	....	....	....	38	.7
Geography	76	....	....	....	....	....	76	1.3
Physics	....	....	....	....	....	228	228	3.9
Chemistry	....	....	....	....	....	228	228	3.9
Elementary science	....	76	....	....	....	....	76	1.3
Trigonometry and solid geometry	....	....	....	....	....	152	152	2.6
Plane geometry	....	76	....	....	190	....	266	4.6
Algebra	....	....	190	152	....	....	342	5.9
Arithmetic	114	114	....	....	....	....	228	3.9
Writing	76	....	....	....	....	....	76	1.3
Drawing	76	76	....	....	....	....	152	2.6
Gymnastics	76	38	38	....	....	....	152	2.6
Music	38	....	....	....	....	....	38	.7
Total	836	912	912	950	912	1,292	5,814	100.0

(2) The range of work accepted by accrediting agencies is shown by the following illustrations:

(*a*) The College Entrance Examination Board recognizes the following subjects as permissible in a standard high-school course:[3]

	Units.[4]		Units.[4]
English, up to	3	Spanish	2
Mathematics[5]	4½	History	4
Latin	4	Science	6
Greek	3	Drawing	1
French	4	Music	2
German	4		

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[1] For a discussion of entrance to college by examination see "*Examinations in mathematics other than those set by the teacher for his own classes.*" International Commission on the Teaching of Mathematics. (Bu. of Educ., Bul., 1911, No. 8.) Washington, 1911.

[2] Quinquennial catalogue Roxbury Latin School, 1915-16.

[3] College Entrance Examination Board. *Document 68*, New York, Dec. 1, 1914, pp. 11-12.

[4] In each case the number of units given is the maximum number which can be taken in the corresponding subject. In mathematics credit may be obtained for any number of half units up to nine.

[5] Three quinquennial volumes of "Examination Questions in Mathematics" of this board have been published in Boston. One volume is for the period 1901-1905, another for 1906-1910, the third for 1911-1915.

(*b*) In contrast to this schedule there are State universities and privately endowed institutions, like Leland Stanford Junior University, which permit a wide range of electives. The University of Minnesota, for example,[1] accepts the following:

	Units.[2]		Units.[2]
English	3 –4	Vocational subjects (made up of the following)	½–4
Mathematics	2 –3½		
Latin	2 –4	Business arithmetic	½
Greek	2	Business law	½
French	1 –4	Bookkeeping	1 –2
German	1 –4	Stenography and typewriting	1 –2
Spanish	1 –4	Freehand drawing	2
Scandinavian	1 –4	Mechanical drawing	2
History and social science	½–7	Shopwork	2
Natural science	½–6	Modeling and wood carving	1
Agriculture	1 –4	Domestic art and science, up to	4
Normal training subjects	1 –3		

(*c*) Finally, it may be of interest to give a composite picture of class work in the 15 States of the North Central Association (Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, and Wisconsin). The percentage of units given in the different subjects of the high schools of these States in 1913–14 was as follows:[3] English (13.1), Latin (11.5), history (9.5), commercial (9.2), German (8.5), algebra (5.2), geometry (4.8), manual training (4.7), physics (3.3), domestic science (3), chemistry (2.6), cooking (2.5), drawing (2.5), sewing (2.4), normal subjects (2.4), agriculture (2.0), botany (2.0), French (1.7), physical geography (1.7), music (1.6), civics (1.5), physiology (1.2), zoology (0.9), education (0.8), other subjects (1.4).

After completing his high-school course our future teacher in one of the secondary schools must of necessity take a college course. There are upward of 800 so-called "colleges" and "universities" in the United States, but many of these are really secondary schools. In 1908–9 there were only 261 colleges which had 100 collegiate students enrolled in the four regular college classes, or which had an endowment to the amount of $100,000.[4] There are about 40 endowed and 40 State universities[5] in the United States. The student who wishes to go to one of the chief university mathematical centers would probably select one of the following: Harvard, Chicago, Illinois, Princeton, or Columbia.

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[1] Illustration given by Capen (*l. c.*).

[2] In each case the number of units given is the maximum number which can be taken in the corresponding subject.

[3] G. S. Counts, *A Study of the Colleges and High Schools in the North Central Association*. (Bu. of Educ., Bul., 1915, No. 6.) Washington, 1915, p. 115. See also the association's "investigation into the status of the teaching of almost all subjects appearing in the secondary schools, programs of study," by L. V. Koos: *The Administration of Secondary-School Units*, Supplementary Educational Monographs, University of Chicago, vol. 1, No. 3, July, 1917.

[4] Monroe's *Cyclopedia of Education*, vol. 2, p. 74.

[5] There are also about 50 State colleges. See *Statistics of State Universities and State Colleges* (Bu. of Educ., Bul., 1917, No. 55), Washington, 1918.

The college course leads to the degree of A. B., Sc. B., Litt. B., Ph. B., or some other degree of similar rank, but the title alone does not convey a very definite idea of achievement.[1]

As to work leading to the degree of A. B., some colleges do not require any courses in mathematics; others require higher algebra, solid geometry, plane and spherical trigonometry, plane and solid analytic geometry, calculus and differential equations. But the normal requirement is a three-hour semester course in each of the subjects: (1) Higher algebra, or (2) solid geometry, and (3) plane trigonometry.[2] If our undergraduate student wishes to proceed in mathematics beyond the required work, the opportunities for doing so vary widely with different colleges. In one none but required courses in mathematics are offered; in another so many courses in mathematics are offered that under the "elective system" there in vogue it would be possible for the student to elect the major part of the courses he takes for his degree from those given by the department of mathematics.

THE TRAINING OF TEACHERS FOR SECONDARY SCHOOLS.

But before going into this question more particularly let us consider how a student who is taking a college course may definitely prepare himself to be a high-school teacher. To get a broad view of the question, we should recall the "joint recommendations of the committee of seventeen on the professional preparation of high-school teachers," adopted by the National Education Association.

> The committee on the preparation of high-school teachers recommend:
>
> I. That the academic preparation include the following elements:
>
> *A*. A detailed and specialized study of the subjects to be taught. The program of studies selected by each student should include work in subjects outside of those in which he is making special preparation, sufficient to give some insight into different fields of knowledge and to avoid the dangers of overspecialization.
>
> *B*. One or more subjects from a group including history, economics, and sociology, which will give the teacher a proper outlook upon the social aspects of education.
>
> *C*. A course in general psychology and at least one from a group of subjects including history of philosophy, logic, and ethics, which will give the teacher a proper outlook upon education as the development of the individual.

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[1] In 1911 the Bureau of Education published an interesting *Classification of Universities and Colleges with Reference to Bachelor's Degrees*. The author, Dr. K. C. Babcock, a specialist in the bureau, divided the institutions into four classes. The first and highest class he defined as "Institutions whose graduates would ordinarily be able to take master's degree at any of the larger graduate schools in one year after receiving their bachelor's degree, without necessarily doing more than the amount of work regularly prescribed for such higher degree." In the first class were only 15 State and 44 endowed and private institutions. See also Rep. of U. S. Commis. of Educ. for 1914, vol. 1, Washington, 1915, p. 168.

[2] Compare *Undergraduate Work in Mathematics in Colleges of Liberal Arts and Universities*. International Commission on the Teaching of Mathematics. (Bu. of Educ., Bul., 1911, No. 7.) Washington, 1911.

II. That definite study be given to each of the following subjects, either in separate courses or in such combinations as convenience or necessity demands:

- *A*. History of education.
    1. History of general education.
    2. History of secondary education.
- *B*. Educational psychology with emphasis on adolescence.
- *C*. The principles of education, including the study of educational aims, values, and processes. Courses in general method are included under this heading.
- *D*. Special methods in the secondary-school subjects that the students expect to teach.
- *E*. Organization and management of schools and school systems.
- *F*. School hygiene.

III. That opportunity for observation and practice teaching with secondary pupils be given.

The committee recognizes the difficulties involved in this recommendation, but believes that they are not insurmountable. Each of the following plans has proved successful in some instances:

- *A*. The maintenance of a school of secondary-school grade that may be used for observation and practice.
- *B*. Affiliation with public or private high schools so situated geographically that practice teaching can be done without interfering with other work of the college course.

In addition to the above, the committee suggests that where competent critical supervision is possible, cadet teaching, in schools more remotely situated, may be attempted. In such cases, a teacher's diploma might be granted after a year's successful work as a cadet teacher.

IV. That the minimum requirement for a secondary-school teacher be graduation from a college maintaining a four-year course and requiring four years of high-school work for admission, or from an institution having equivalent requirements for admission and giving equivalent academic scholarship.

A year of graduate work divided between academic and professional subjects is desirable. Discussions of the relative value of college and normal schools for secondary-school teachers are to be found in the references below.[1]

V. That the study of subjects mentioned under II be distributed through the last two years of the college course.

The proportional amount of time given to these subjects will vary with local conditions, but an irreducible minimum is one-eighth of the college course. They should be preceded or accompanied by the subjects mentioned in I B, C. Recommendations as to the amount of time given to particular courses will be found in several of the accompanying papers.[2]

It will now be illuminating to consider in detail a definite scheme involving practice teaching in a manner which has won high praise from prominent authorities in recent writings.[3] I refer to the pioneer system at Brown University, in Providence, R. I., where it has been in operation for over 20 years. The fundamental principles of the scheme which has been advocated as worthy of wide acceptance have been summarized by Prof. Jacobs as follows:[1]

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[1] Given on p. 538, Proc. Nat. Ed. Assoc., 1907.

[2] See the report in Proc. Nat. Ed. Assoc., 1907, pp. 521–668.

[3] J. F. Brown, *The training of teachers for secondary schools in Germany and the United States*, New York 1911, p. 242f. W. S. Learned, *The Oberlehrer, A study of the social and professional evolution of the German schoolmaster*. (Harvard Studies in Education, Vol. I). Cambridge, Mass., 1914, p. 131f.

1. Practice teaching should be open only to graduate students; that is, students who hold a bachelor's degree. This rule is inflexible and has never been broken. Brown University looks askance upon the custom which has developed of including practice teaching and extended professional preparation as a part of the four years' work for the first college degree and regards it as a lowering of standards. It holds that a fifth year of college work is necessary to the proper preparation of secondary-school teachers.

2. Practice teaching should be under actual schoolroom conditions. Hence, Brown University uses for its practice teaching the public and private secondary schools of the city of Providence and neighboring cities and towns.

3. Practice teaching should include the *continuous* instruction and control of a class for a long period. At Brown University the amount of practice teaching required varies from a minimum of 5 periods a week to 15 periods a week for one year. Student teachers teach very few classes, but they teach them continuously for a semester or a year. After many trials it has been found best to limit the student teachers to one or two subjects. To give a few sporadic lessons before a class is one thing; to teach a subject continuously is quite another matter.

4. Practice teaching must be under the continuous direct or indirect supervision of an experienced teacher who knows the school, the class, and the detailed progress of the subject taught. Hence, all supervising teachers at Brown University are selected from the experienced teachers of the schools. Each student teacher has one supervising teacher, and each supervising teacher one student teacher. The work is strictly individual.

5. Practice teaching must be closely correlated with the university work. At Brown University supervising teachers are selected by the university and paid a small remuneration. Each student teacher is visited once a week by the professor in charge of the practice teaching, and private conferences are held. He also meets once a week in a general conference all the student teachers. Plan books for the past week are presented and discussed and later returned to the student teachers. Student teachers are at the same time pursuing other courses—(1) in education, a course in secondary education and a seminary in current educational problems, and (2) in departments allied with the subjects they are teaching.

Student teachers who teach more than five periods a week usually receive some remuneration for their work from the school. In the case of the city of Providence this is provided for by an agreement between the university and the city of Providence. In other cases it is arranged as the cases arise. Student teachers who have shown themselves efficient are assigned other classes under supervision. For this work they receive remuneration. The work then becomes closely similar to what is known as "part-time work" in vocational education. The work at Brown University, however, long antedates the vocational "part-time work."

Graduate students who are admitted to the practice teaching at Brown University usually have taken as undergraduates four semester courses in education. These courses are: History of education, principles of education, educational psychology, and general method. In the last course there is some systematic work in observation and some teaching of the class by members of the class. For this last purpose the class is divided into sections of about 10 each. The student, then, who is admitted to the graduate practice teaching, is not a mere novice, but one who has already had some experience.

6. The last principle is one which is fundamental and appears in all of the work. Practice teaching must not be an injury to the school or to the pupil, but rather a

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[1] *School and Society*, Apr. 8, 1916, vol. 3, p. 534.

benefit. Hence the student teacher is called upon freely to assist the supervising teacher or the principal of the school in doing a limited amount of clerical work, work with individual pupils, or other work which can be assigned with profit to the student teacher and to the school alike. The student teacher becomes, to all intents and purposes, a part of the school staff, subject to regulations as other teachers and working as the other teachers are, in harmony with the general purposes and spirit of the school. The work of the student teacher is frequently superior to that of many of the regular teachers. He has more time for preparation and individual work with pupils and frequently more enthusiasm.

But, quite apart from these general requirements for all teachers, the department of mathematics at Brown University lays down a minimum course of study which it requires students who are prospective teachers of mathematics to take if they wish the backing of the department in starting on their careers. In outline the course is as follows: Plane trigonometry (3 semester hours), higher algebra (3), solid geometry (3), plane analytic geometry (4), differential and integral calculus (8), teachers' course in algebra (6), and teachers' course in geometry (6). The teachers' course in algebra constitutes an introduction to some of the concepts of modern analysis. Among the topics treated are: The number system with special reference to irrational numbers, limits, infinite series, the fundamental operations, and determinants.

In the teachers' course in elementary geometry the student is taught: Methods for attacking Euclidean problems; discussions of famous problems; the existence of transcendental numbers and the proofs of the transcendence of e and π; means of rigorous discussion of the more delicate and difficult parts of the subject, such as the systems of axioms; something about (*a*) the history and literature of elementary geometry; (*b*) the most important French, German, and Italian texts; and (*c*) non-Euclidean geometry.

The students are also urged to take a year each (three hours a week) in physics and chemistry, in addition to the courses in education and psychology referred to above. For the A. B. degree they are required to take, also, 12 hours in rhetoric, composition, and English literature; 6 hours in European history; 6 hours in economics and either social or political science. Other courses are elective.

Students preparing to teach in secondary schools constantly elect further mathematical work, such as (1) the two-hour course in differential equations; (2) the six-hour course in theory of functions of a real variable (text, first part of Goursat-Hedrick's *Mathematical Analysis*); (3) the six-hour course in functions of a complex variable (text, Pierpont's or Burkhardt-Rasor's work); (4) six-hour course in differential geometry (text, latter part of Goursat-Hedrick's work and Gauss's memoir); (5) six-hour course in projective geometry; (6) three-hour course in solid analytic geometry; (7) three-hour course in tangential coordinates (French text by Papelier); (8) three-hour course in algebra (German text by Weber, Band 1).

In the United States, as in Germany, the general courses in colleges and universities have exerted more potent influences in molding teachers of secondary schools than any courses in professional training. All the better secondary schools now require that newly appointed teachers shall be college graduates. Moreover, the ideals embodied in the report of the committee of seventeen are rapidly becoming generally accepted and have led to yet higher standards on the part of many schools of the best type.

From the Atlantic to the Pacific there is constant development of schools of education, and the greatest in the country are associated with, or integral parts of, universities. Perhaps the School of Pedagogy of New York University, Teachers College of Columbia University,[1] and the School of Education at the University of Chicago are the most prominent—the last two being the only schools of the type organized for research work in the teaching and history of mathematics leading to the degrees of A. M. and Ph. D.

Another great source of benefit and training to secondary-school teachers is the opportunity offered by the recent unparalleled development of summer schools. In 1913, in a group of 29 university summer schools, 282 courses of the character of professional courses in education were offered.[2] Such courses are especially valuable in inspiring those teachers who desire to continue their studies during vacations.

The enormous increase in the number of high schools during the past 20 years makes the problem of training teachers for them a serious one. While the State normal schools [3] throughout the country deal effectively with the problem of preparing teachers for elementary schools, the training of high-school teachers is a small part of the work of a few of the schools. In no case can this training be considered adequate from the point of view of the standard set by the "Committee of Seventeen." But apart from normal schools, although in practice this standard is fully maintained in such a State as Rhode Island, for example, there and in every other State except California the *legal* requirements for certification of high-school teachers are not commensurate with that standard.[4]

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[1] The Teachers College, Columbia University, was changed into a graduate school in 1914.

[2] Rep. of U. S. Commis. of Educ. for 1913. Washington, 1914, vol. 1, pp. 545-551.

[3] Statements made in this connection are based upon Ch. XII in *Problems involved in standardizing State Normal Schools*, by C. H. Judd and S. C. Parker. (Bu. of Educ., Bul., 1916, No. 12.) Washington, 1916.

[4] For full details on "The Certification of American Teachers," see pp. 207-235 of *The Training of Teachers for Secondary Schools in Germany and the United States*, by J. F. Brown. New York, 1911.

As to the "tangible rewards" which form an attraction to the high-school teacher we are able to give some statistics but recently accumulated and published.[1]

The salaries for men and women in city high schools range about as follows:

1. In cities having more than 250,000 inhabitants.

	Minimum.	Maximum.	Average.
Principal	$1,700	$5,000	$3,565
Vice principal	1,000	2,850	2,164
Head of department	1,260	4,000	1,951
Teacher	450	3,150	1,746

2. In cities having 5,000 and fewer than 10,000 inhabitants.

	Minimum.	Maximum.	Average.
Principal	$360	$2,500	$1,314
Head of department	618	1,800	947
Teacher	100	1,800	795

Cities with a population of more than 250,000.

San Francisco:	
Principal	$3,000-$3,300
Vice principal	2,100
Head	2,040
Teacher	1,500- 1,680
Chicago:	
Principal	3,000- 3,600
Vice principal	2,100- 2,600
Teacher	1,000- 2,600

New York:	
Principal	$3,150-$5,000
Teacher	900- 3,150
Boston:	
Principal	2,844- 3,924
Head	2,340- 3,204
Teacher	1,260- 3,060

Cities with a population less than 250,000.

Albany:	
Principal	$3,000
Head	$1,900- 2,200
Teacher	900- 1,900
Providence:	
Principal	3,000
Vice principal	2,200
Teacher	550- 2,200

Oakland:	
Principal	$3,600-$3,300
Vice principal	2,000- 2,200
Teacher	1,380- 2,100

Cities with a population of less than 100,000 but greater than 50,000.

Springfield:	
Principal	$2,800
Head	1,300
Teacher	$800- 1,400

Troy:	
Principal	$2,500
Vice principal	1,600
Head	1,600
Teacher	1,500

Cities with a population of less than 50,000 but greater than 25,000.

San Diego:	
Principal	$2,700
Vice principal	2,208
Teacher	$1,416- 2,004

Salem:	
Principal	$2,700
Teacher	$400- 1,600

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[1] *The Tangible Rewards of Teaching. A detailed Statement of Salaries paid to the several Classes of Teachers and School Officers.* (Bu. of Educ., Bul., 1914, No. 16.) Washington, 1914.

In the 15 States of the North Central Association already referred to, G. S. Counts gives the following table of median salaries for cities of different sizes:[1]

Median salaries in 15 cities.

	Under 2,500.	2,501-5,000.	5,001-7,500.	7,501-10,000.	10,001-15,000.	15,001-50,000.	50,001 and over.	Total.
Median salary for superintendents....	$1,628	$1,750	$1,950	$2,000	$2,290	$2,700	$2,700	$1,821
Median salary for principals..........	1,058	1,140	1,292	1,445	1,587	2,006	3,014	1,358
Median salary for teachers............	723	965	793	861	906	970	1,381	919

The first system of teachers' pensions to be established in the United States appears to be that of Chicago, which was inaugurated in 1893. By the year 1900 nine other systems had been founded. By 1910 there were 25 more. Nearly half (31) of all of the systems, however, have come into existence since 1910. * * * There are now State-wide pension systems for teachers in 22 States. There are local systems in 10 more. Thus more than half of the States are represented in the movement.[2]

The 65 pension systems are generally administered by special boards, in which the teachers constitute a majority. Provision is as a rule made for retirement on the basis of service and disability, but usually only for teachers entering the service after the establishment of the system. Funds are in most cases provided by teachers' contributions and by public appropriation in approximately equal amounts, but the funds arranged for are frequently insufficient to pay the pensions that have been promised.

In all the systems retirement is on the basis of from 20 to 40 years' service, most frequently 30 years. Teachers contribute to the funds in four-fifths of the systems, most frequently 1 or 1½ or 2 per cent of their salaries. The representative salary (the median averages ranging from $307 to $1,197) of the teachers in 61 systems reporting is $665 a year. The representative pension in these systems (60 reporting) is $500 a year (the median of averages ranging from $181 to $1,050).

For full information regarding systems of teachers' pensions the reader should consult the seventh, eighth, ninth, tenth, eleventh, and twelfth reports of the Carnegie Foundation, and the bulletin by Ryan and King.[3]

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[1] *A Study of the Colleges and High Schools in the North Central Association* (Bu. of Educ., Bul., 1915, No. 6), Washington, 1915, p. 67.

[2] This paragraph and the facts which follow are taken from the admirable "Summary of Teachers' Pensions Systems" in the *Tenth Annual Report* of the Carnegie Foundation for the Advancement of Teaching. New York, Oct., 1915, pp. 100-102. In organizing the pension systems no distinction has been made between elementary and secondary teachers.

[3] W. C. Ryan and R. King, *State Pension Systems for Public-School Teachers*. Prepared for the committee on teachers' salaries, pensions, and tenure, of the National Education Association. (Bu. of Educ., Bul., 1916, No. 14). Washington, 1916. 46 pp.

Bibliography, pp. 23-26. Typical pension and retirement laws, pp. 27-39.

No consideration of the various forces which influence and tend to raise the standards for the training of teachers in the United States would be complete without reference to the exchange of teachers between Prussia and the United States. In response to a request from the Prussian minister of education the trustees of the Carnegie Foundation for the Advancement of Teaching voted in 1907 to authorize the president of the foundation to act as the agency in America for an exchange of teachers of English between the United States and Prussia. Since that time about 40 of our college and high-school teachers drawn from more than a score of States have been cordially received in Prussian secondary schools, and a like number of Prussian Oberlehrer sent to us were located in college, university, academy, and high school. Several of our teachers sent over were teachers of mathematics, one of them being a college professor.

The advantages, direct and indirect, accruing from the exchange have been very great, and more general acquaintance with the efficiency and worth of Germany's system of secondary education will surely be a source of weighty influence for progressive reform in this country.[1]

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3. *Mathematics in the Public and Private Secondary Schools of the United States.* (Bulletin, 1911, No. 16), 1911.
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[1] For details concerning the exchange of teachers between Prussia and the United States, the following publications of the foundation should be consulted: (1) *A Plan for an Exchange of Teachers between Prussia and the United States*, 1908; (2) Annual Reports, 3 to 8, inclusive.

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XIX. SUMMARY AND COMPARATIVE REMARKS.

A summary of some of the principal facts in connection with the training of teachers for secondary schools as well as comment, mainly of a comparative nature, is given in the following paragraphs. All statements should be considered in the light of the fuller discussion in earlier pages.

I. *Australia.*—The standards for the training of secondary teachers in Victoria and New South Wales are those to which all States of the Commonwealth are approaching. In the Teachers' College and University at Melbourne, Victoria, the usual course of training lasts four years—three years to obtain the B. A. or B. Sc. degree and one year of special professional training. The professional training includes (1) attendance at lectures in the university on theory of education with special reference to the method of teaching the various subjects; and (2) 120 hours of teaching under supervision in primary and secondary schools. In New South Wales similar requirements of at least four years of training after leaving the high school are maintained. Professional work is taken up after graduation from the university. This consists in part (1) of study in philosophy, education, principles of teaching, and school hygiene; (2) of continuous practice teaching (8–10 hours a week). In neither Victoria nor New South Wales is it necessary that the teacher shall have had special courses in mathematics in the university. On the other hand the better schools prefer graduates with "honors" in mathematics.

II. *Austria.*—To a certain extent the provisions for the training of secondary school teachers and the conditions under which they work are similar to those prevailing in Germany.

The training required for candidates as teachers in the Austrian Gymnasium and Realschule is practically the same. There must be not less than three and one-half years of scientific and other preparation (not always good) at a university. After five semesters the preliminary examination in philosophy and pedagogy may be taken. When this is passed application may be made not earlier than the end of the seventh semester for the Lehramtsprüfung, with its Hausarbeiten and oral examinations. After this, in theory only one year of practical training at a Mittelschulseminar is required, while a second year is permitted. But in practice very few candidates have had more than a minor part of the training of even a single Probejahr before taking up actual teaching.

The written and oral examinations for the Lehramtsprüfung may include mathematics as (1) a major or (2) a minor. In the former case (1) the candidate must be familiar with "general arithmetic," the foundations of higher algebra and theory of numbers and their significance for elementary mathematics, elementary geometry, synthetic and analytic geometry, differential and integral calculus and its applications to geometry, the elements of the calculus of variations and foundations of the modern theory of functions, and the principal results of investigations concerning the foundations of mathematics. (2) When mathematics is a minor it is demanded that the candidate shall have knowledge of elementary arithmetic, insight into the structure of the field of real numbers and into operations with them; knowledge of elementary geometry to the extent of what is taught in secondary schools, and exercises in space perception; accuracy and speed in the solution of simple examples applying the idea of a function and the elements of differential and integral calculus to functions coming up in secondary school work.

The candidate is given three months to prepare the Hausarbeit on some subject not discussed in the lectures at the university. With mathematics as major recent Haubsarbeiten have dealt with such topics as: "The theory of Fourier series"; "Theta functions and their applications in theory of surfaces of the fourth order"; "Method of derivation of large prime numbers"; and "Algebraic treatment of the 27 lines on a cubic surface." With mathematics as a minor: "Weierstrass's theory of irrational numbers," "Properties of the nine-point circle," and "The theorems of Fermat and Wilson."

The Probejahr includes observation of teaching methods, practice teaching under directions, the preparation of reports and weekly conferences with the staff of the Seminar on such matters as teaching, school discipline, pedagogy, school hygiene, and new publications of interest to teachers.

It is deplored that teachers of mathematics in the Untergymnasia and Unterrealschule may have had only the scientific training required when mathematics has been taken as a minor.

III. *Belgium.*—The diplôme de sortie of an athénée royal, or of certain of the collèges entitles a student to enter one of the universities at which all teachers of the athénées are prepared. The inspectors of studies and professors in an athénée and the rector (or head) of a lower middle school must have secured the doctor's degree, and the masters (surveillants) in an athénée must have the university diploma of "candidate." (The four universities include two State establishments, the free university at Brussels, and the Roman Catholic University at Louvain.)

During the first two years the student prepares for examinations leading to the certificate as "Candidate in physical sciences and mathematics."[1] The examinations of the first year are on: Analytic geometry, plane and solid; descriptive geometry; higher algebra and the elements of the theory of determinants; differential and integral calculus (first part); analytic statics; experimental and laboratory physics. For the second year: Logic; psychology; moral philosophy; projective geometry; integral calculus (second part); elements of the calculus of variations and calculus of differences; pure kinematics; crystallography; and laboratory exercises.

The first examinations for the doctorate occur at the end of the third year. They are on: Higher analysis; dynamics; general mathematical physics; spherical astronomy and elements of mathematical astronomy; elements of the calculus of probabilities with the theory of least squares.

The subjects of the second set of examinations for the doctorate (in the fourth year) include: Mathematical methodology; elements of the history of the physical sciences and mathematics; and one of the five following groups chosen at pleasure by the candidate: (*a*) Higher analysis; (*b*) higher geometry; (*c*) analytic mechanics and celestial mechanics; (*d*) mathematical astronomy and geodesy; and (*e*) experimental physics and mathematical physics. The examination in the "group" chosen is somewhat searching, as the thesis has to do with the development of some part of it. The thesis must be publicly defended. Prospective teachers must also give two public "lessons," the subjects for which are designated in advance by the jury and chosen from the program of the athénées.

The young doctor is qualified to teach in an athénée at once without any professional training. In general, it is, however, only after several years in some such minor position as surveillant that he may reach the status of a professor in an athénée. In the large cities, the salaries, corresponding pensions, and social position connected with such a chair are attractive.

IV. *Denmark.*—The university course for the scientific training of a teacher for a secondary school usually ends in about six years, with the Skoleembedsexamen. This examination consists of two parts, covering the major and two minors; if the major is mathematics, the minors are astronomy with applied mathematics, and chemistry with physics. But in addition to these at the end of the first year the candidate must pass the "Filosofikum," an examination in logic, psychology, and the elements of the history of philosophy. This entitles him to the degree candidatus philosophiae. Having passed the Skoleembedsexamen he is candidatus magisterii. After two years of professional training (a year in the State Pedagogic Seminary and a year as assistant, or regular teacher, in a State or private secondary school), or its equivalent, the candidate is finally examined as to eligibility to teach. In view of the eight years of such training, the salaries are pitifully small.

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[1] This certificate very nearly corresponds to the bachelor's degree in this country.

In the first part of the Skoleembedsexamen the mathematical subjects include: Plane and solid analytic geometry, theory of infinite series, differential equations with a single independent variable, total and partial linear differential equations in three variables, differential geometry, statics, kinematics, hydrostatics, and advanced portions of gymnasial mathematics from a higher point of view. The second part of the examination with mathematics as a major includes questions on such subjects as function theory, elementary number theory, methods of descriptive geometry, synthetic and analytic projective geometry, and mathematical history.

V. *England.*—The amount of mathematics taught in English secondary schools varies from such a program as the elements of arithmetic, algebra, and geometry required for a London University matriculation examination, to programs which include trigonometry, synthetic and analytic geometry, theory of equations, differential and integral calculus, statics and hydrostatics—indeed all subjects necessary to prepare for an entrance scholarship examination in mathematics at Cambridge University, for example. In the mathematical training of the teacher there is corresponding variation. In practically all cases it is necessary for a candidate for a position to be a college graduate. But on the one hand he may have received a "pass" degree, in three years, without any college work in mathematics; and on the other hand he may have spent four years in obtaining a degree with first-class honors in mathematics. As to the extent of the professional training, this does not exceed a year in the training college of what we call the graduate school of a university, but even this is not yet always insisted upon. Athletic abilities are a valuable asset for a man seeking a position. The salaries are often very low.

That first-class scientific and professional training is not generally demanded of candidates for positions as teachers of mathematics in secondary schools indicates a marked similarity between the standards in England and the United States.

VI. *Finland.*—The steps required in the preparation of the secondary school teacher of mathematics after leaving the lyceum are: (1) To pass the examinations for a "candidate of philosophy," or for the "certificate of aptitude in teaching" after four or five years of preparation in the university; then (2) to spend a year of professional training in one of the normal lyceer; and (3) to pass an examination in theoretical and practical pedagogy. In each of the examinations, grades approbatur, approbatur cum laude, and laudatur are assigned.

A professor in a secondary school must have the degree of "candidate of philosophy" with highest grade in the major subjects required by the post. For the assistant professor, the same degree, or "certificate of aptitude," with at least the second highest grade in the major subjects required by the position, is necessary.

The "candidate of philosophy" has had courses in spherical trigonometry, analytic geometry, differential and integral calculus, differential equations, theory of numbers, theory of functions of a complex variable, and occasional courses in such subjects as minimal surfaces, theory of groups, and elliptic functions.

VII. *France.*—The highest type of secondary school in France is the lycée. The following remarks are with reference to preparation of teachers for this institution. The tendency of recent legislation is to demand that all teachers shall have passed the examination of the agrégation. The requirements of this examination in respect to knowledge of mathematics and dextrous handling of materials are unparalleled by any other country. Professional training, in comparison with the amount required by Denmark or Prussia, is comparatively neglected, and this has been judged by some as a weakness in the French preparation. It should be borne in mind, however, that it is difficult for an intelligent Frenchman (and the agrégés are the élite of the country's intellectuals) to be otherwise than interesting, effective, and elegant in his exposition of any subject.

The bachelor who wishes adequately to prepare himself as a mathematical teacher in a lycée usually undergoes the strenuous training of the classes de mathématiques spéciales in mathematics, physics, chemistry, descriptive geometry, drawing, German, and French. This preparation, covering at least two years, equips him for the university, where the three-year course continues to be of a highly specialized character. The best students pass the examination for the *licence* at the end of the first year, other tests at the end of the second, and present themselves for the terrific concourse of the agrégation at the end of the third year. Pedagogics and practice teaching form a very meager part of the training of the teacher.

The annual number of agrégés has never exceeded 14. For the years 1885–1909 there were only 300, of whom 178 were trained at the famous École Normale. In 1909, of the 300 agrégés 51 had also become docteurs ès science mathématiques. Such a doctorate ranks far higher than any German doctorate, the acquisition of which has been made part of the preparation of many Oberlehrer.

As to the mathematical attainments of the agrégé, they are equaled by those of only a very small percentage of professors of mathematics in American colleges.

VIII. *Germany.*—Among the nations of the world, Denmark, France, Sweden, and Germany certainly maintain the highest standards in the selection of teachers for their better secondary schools. And no small part of the remarkable training which these teachers get is from master minds and master teachers in the schools themselves. Germany insists much less than France on brilliancy and breadth of mathematical attainment, but, like Denmark and Sweden, decidedly more on theoretical and practical professional training.

The candidate for teaching in a secondary school in Prussia is examined by a commission composed partly of professors and partly of State officials. Before the commission he must place—(1) his Maturitätszeugnis from a Gymnasium, Realschule, or Oberrealschule; (2) documents to show that he has spent at least three years in study at one or more German universities (in point of fact candidates usually spend four or five. For three of the six semesters required the mathematician may have attended a technical high school); (3) a statement of the subjects (for example, pure mathematics and physics and applied mathematics) and classes (Sexta to Untersekunda, inclusive, or Obersekunda to Oberprima, inclusive) for which the candidate hopes to prove his qualifications; and (4) a statement of the field in which he wishes to receive subjects for required essays. Not more than three months, ordinarily six weeks, are allowed to prepare the essays. For one of them some publication of note, such as the candidate's doctor's dissertation, may sometimes be substituted.

The written and oral examinations are in philosophy, pedagogy, religion, German literature, and the candidate's special subjects. For first-grade rank in pure mathematics the candidate must show that he is thoroughly acquainted with the principles of higher geometry, arithmetic, algebra, higher analysis, and analytical mechanics and can solve fairly difficult problems without assistance.

Having passed these examinations pro facultate docendi, the Schulamtskandidat must still undergo two years of severe professional training, (i) the Seminarjahr and (ii) the Probejahr.

When favorable report has been made on the work of the Probejahr the candidate's name is put on a list of teachers eligible to appointment in the higher schools of the province in which the examination was held.

Several German States follow Prussia's method of training teachers for secondary schools. Others differ in various ways: Bavaria, Saxony, Wurtemberg, Baden, and Hesse each require four years at a university; in Wurtemberg the Seminarjahr is unnecessary; and Bavaria, Baden, and Alsace-Lorraine demand no Probejahr. There are also differences in details, even when general requirements are the same. But throughout the Empire the attractions of the teacher's position are sufficiently strong to draw some of the best mathematical talent of the country.

IX. *Hungary.*—The method of training secondary school teachers in Hungary is more adequate than that in Austria. Recruits for such training are drawn from among the graduates of the Gymnasia and Real Schools. The elaborate and searching training is carried on during five years at a university, or in the Polytechnikum, and at a training college. In starting out, the candidate must elect two subjects which he wishes to teach; the selection of a third is recommended. Mathematics, physics, and descriptive geometry are not uncommonly chosen together.

The examinations in the course are threefold: (1) The general examination, at the end of the fourth semester; (2) the examination on special subjects, at the end of the eighth semester; and (3) the pedagogic examination at the end of the next year, which the candidate usually employs in professional practice.

In the general examination the oral part contains questions in plane and spherical trigonometry, analytic geometry, analysis, descriptive geometry, physics, the Hungarian language, and one modern language (German, French, English, or Italian) with the literature of the same.

Five months before the examination in special subjects the candidate is given a theme in each of his subjects, upon which he has to write a dissertation. These dissertations must indicate originality, familiarity with literature, and broad knowledge of the themes. In the oral examinations on special subjects the candidate must show decided proficiency. The oral examination in mathematics is on—(1) The mathematics of secondary schools; (2) certain parts of geometry, algebra, and analysis common for all candidates; and (3) the following five subjects, one of which must be known thoroughly, the others, in a general way: (*a*) Modern geometry and the theory of algebraic forms; (*b*) number theory and higher algebra; (*c*) general theory of skew curves and surfaces; (*d*) general theory of analytic and elliptic functions; and (*e*) advanced portions of integral calculus.

The examination in pedagogy consists of a dissertation and an oral examination in history of philosophy, logic, psychology, pedagogy, history of pedagogy, and special methods for teaching mathematics. While this examination occurs at the end of the fifth year, most of the courses of study have been taken during the first four years at the university. The fifth year is largely devoted to training and practice teaching in a Seminar, such as Kármán's, or the State training college. Teachers do not attain to full service until after three years of probationary activity.

X. *Italy.*—A candidate for a position as teacher of mathematics in a secondary school must possess the degree of Dottore in matematiche pure from one of the universities. After the candidate has graduated from a liceo or an istituto four, sometimes five, years are devoted to securing this degree. With an exception to be referred to presently, the courses of study are wholly in pure and applied mathematics and allied fields. An idea of the breadth of some of these courses may be obtained by recalling that the following works consist mainly of university lectures: F. Severi's Lezione di geometria algebraica (1908); E. Ciani's Lezione di geometria proiettiva ed analitica (1912); and G. Castelnuovo's Lezione di geometria analitia (1913).

The first two years of study lead to the certificate licenza dell' universitá. During the last two (or three) years the student (1) carries five advanced courses (theoretic geodesy being put on a plane with higher analysis), (2) writes a dissertation, and, if he wishes to occupy an advantageous position with respect to appointments, (3) attends lectures on methods of teaching leading to the diploma di magistero (these lectures are given in the scuola di magistero of the university). The final examinations of the university lead to the laureate, of which there are many grades.

The student who has read nothing but what was suggested in lectures is not likely to pass out with "full wishes and praise," as the highest grade is called, nor will the most favorable opportunities probably be waiting for him in future; still he has the highest degree which the university confers. The dissertations, as is natural, present great variation in value and originality. The candidate is required to publish a full résumé of his results, but not the thesis itself; whereby a long-suffering mathematical public is spared much, for the feebler dissertations never see the light. The better ones find ready acceptance by the mathematical journals or are laid before learned societies.

The first appointment of a teacher in a secondary school is for three years, after which the appointment may be made permanent if the inspector's report is favorable; if not, the appointment is extended for another year, when the teacher is definitely appointed or dismissed.

In the preparation of the teacher the lack of professional training is regarded as serious by many; his scholastic equipment in his special subject is probably equal to that of the Oberlehrer.

XI. *Japan.*—The usual method of preparation as a teacher in a middle school is (1) to take the course of four years in one of the higher normal schools whose graduates are granted teachers' licenses; or (2) to attend some similar institution and pass the four grades of examinations set by the department of education for the license. A *gakushi* of the faculties of science in the universities of Tokyo and Kyoto, who has no professional training, is entitled to receive a license without examination. Similar privileges are accorded to graduates of foreign universities.

The courses in the higher normal school which prepare teachers of mathematics and physics include professional training, teachers' courses in algebra and geometry, higher algebra, plane and solid analytic geometry, and differential and integral calculus. The four grades of examination in mathematics set by the department of education are in (1) arithmetic, algebra, and geometry; (2) trigonometry; (3) analytic geometry; and (4) differential and integral calculus.

Teachers in the eight higher middle schools, which are closely allied to the universities in their organization, are nearly all gakushi in mathematics. At the university the gakushi have passed examinations in calculus and differential equations, solid analytic geometry, projective geometry, astronomy and least squares, general physics, general dynamics, and theory of numbers.

XII. *The Netherlands.*—Gymnasia prepare students to enter directly the various departments of the universities, but graduates of higher burgher schools must pass university examinations in Latin and Greek. The first examination after entering the university is the examination for candidature, at the end of about three years; the second examination, that for the doctorate, occurs at the end of about six years of study. If, in addition to passing the latter examination, the candidate prepares for the faculty an appropriate thesis, he is entitled to the degree of doctor. It is from those who have passed the examination for the doctorate that teachers for gymnasia and higher burgher schools are almost wholly recruited. They have had absolutely no professional training.

A candidate for appointment as teacher in a three-year or five-year higher burgher school may also prepare himself for the position by passing a series of exceedingly elaborate examinations, the preparation for which is made entirely outside of the universities. For the five-year school, examinations on the following subjects, among others, must be passed: Plane and spherical trigometry, descriptive geometry, analytic geometry, calculus, theoretical and applied mechanics, physics, chemistry, cosmography, geology, and mineralogy. During the past 50 years exceedingly few have qualified themselves as teachers in this way.

Some of the subjects leading to the examination for the doctorate are higher algebra, calculus, plane and solid analytic geometry, descriptive geometry, differential equations, theory of functions, differential geometry, calculus of variations, and mathematical physics.

XIII. *Roumania.*—Graduating from the lycée when about 19 years of age, the student prepares himself to be a secondary teacher by study for (1) the diploma, licence ès sciences mathématiques of a university; and for (2) the certificate of a pedagogic seminar. The examinations for the license are in higher algebra, analytic geometry, descriptive geometry, differential and integral calculus, theory of functions, mechanics, and astronomy. It takes at least three years to prepare for these examinations. Professional training is obtained at a pedagogic seminar.

A candidate for the position of secondary teacher should have passed the examination of capacity. To be admitted to this examination the student must possess the diploma and certificate mentioned above.

The organization of the secondary schools and the training of teachers for them is very similar to that in France. In Roumania perhaps more emphasis is put on professional training.

XIV. *Russia.*—Graduates of the gymnasium and of the seven-year "real school" are entitled to register in faculties of the universities. The course for teachers in the gymnasia, as well as for most teachers in the "real schools," occupies four years and leads to a diploma of the first or second grade.[1] The courses for the mathematics-analytic mechanics group at the University of Petrograd include spherical trigonometry, analytic geometry, calculus, partial differential equations, theory of numbers, theoretical mechanics, hydrostatics and hydrodynamics, and astronomy and celestial mechanics.

It was not till recently that any provision was made to give professional training to candidates for teaching positions in State secondary schools. This beginning was made in 1909, when a year course including lectures in logic, psychology, pedagogy and its history, as well as practice teaching, was organized for the arrondissement of Petrograd.

XV. *Spain.*—The bachiller en artes of an instituto may prepare himself to teach mathematics in an instituto at any one of the three universities: Barcelona, Madrid, or Zaragoza. The courses in the faculties of science lead to the licenciatura certificate in about four years; the apt scientific investigator may procure the doctorate in another year. Every candidate for a professorship in the instituto must have a licenciatura certificate; the best positions are obtained by the doctors in mathematical sciences.

The mathematical courses leading to examinations for the licenciatura are as follows: Mathematical analysis, metric geometry, analytic geometry, infinitesimal calculus, cosmography and physical geography, projective geometry, descriptive geometry, rational mechanics, and spherical astronomy and geodesy. (This list of subjects strongly reminds one of those required for the licenza in Italy.) The examinations take on different forms and imply a certain amount of professional training.

To prepare for the doctorate the student must (1) attend courses in higher analysis, higher geometry, astronomy of the planetary system, and mathematical physics; (2) present a memoir on a subject selected by the candidate; and (3) successfully defend the memoir before a tribunal.

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[1] This is not a degree; the degrees of magister and doctor require longer preparation.

XVI. *Sweden.*—The very thorough course of the gymnasium concludes with the studentsexamen, the sole means by which a student may enter one of the universities; mathematics is there taught in the faculty of philosophy. The courses for secondary-school teachers are very elaborate and lead to (1) the filosofisk åmbetsexamen, at the end of about four years of study; and (2) the filosofie licentiatexamen, after about eight years of preparation. Candidates for positions as teachers in the Realskolor are required to pass the first of these examinations; those seeking higher posts in the gymnasia, the second; but in this latter course the candidate must also defend a thesis for the degree of doctor.

In each case the candidate has to spend a probationary year in connection with some one of five special schools which organize excellent professional training. Moreover, before regular appointment as professor or assistant professor in the Government secondary schools, the candidate must have spent at least two years in successfully performing the duties attached to the position. Sweden probably leads the world in the extent of scientific preparation required for her professors (Lektorer) in the gymnasia.

The subjects of the åmbetsexamen include projective geometry, theory of equations, calculus, analytic geometry, theory of numbers, theory of probabilities, ordinary differential equations with constant coefficients; and generally for the highest predicate elements of the theory of (*a*) differential equations, (*b*) analytic functions, and (*c*) differential geometry. In the preparation for the licentiatexamen the candidate is introduced into various important fields of modern mathematics, including ordinary and partial differential equations of mathematical physics.

XVII. *Switzerland.*—Considering the country as a whole, there are no fixed examinations for secondary-school teachers; nor are there any colleges for training them, although there is a department of pedagogy in the University of Geneva. For most of the teaching positions in the secondary schools the majority of the Cantons demand that the candidate shall have completed a university course, or its equivalent, of four or five years. Typical of such Cantons are Fribourg and Geneva. Candidates with two years' training in a university, or its equivalent, can usually only be appointed as teachers in the lower classes of the better schools; an exception requiring the qualifying word is Cantòn Vaud. There is a general tendency to favor candidates who have had technical training such as a student derives from an assistantship in the Polytechnic School.

On the whole, high scientific standards of training are demanded on the part of secondary teachers, but their professional training is almost entirely neglected.

Subjects included in examination requirements for secondary-school teachers in courses of the Polytechnic School and the University of Bern are of the following types: Descriptive geometry, calculus, analytic geometry of three dimensions, projective geometry, theory of functions, Fourier's series and integrals, differential geometry, and theory of transformation groups.

XVIII. *United States.*—Practically all of the best secondary schools require, as a general thing, that a candidate for a teaching position shall be a college graduate. It is usually unnecessary to have had any courses in the theory of education, or any special work in the subjects for which the candidate applies to teach, or any professional training. Other things being equal, candidates equipped in these respects are, of course, more readily employed. Some schools demand such preparation, and colleges and training schools in the country have made provision for meeting such demands.

The standards throughout the United States for the training of secondary-school teachers appear to be very similar to those in England, although the professional training is now, possibly, more insisted upon in the latter country. As a general thing, salaries constitute perhaps the chief attraction to college-trained men to take up secondary-school work in the United States.

CONCLUSION.

In the preceding pages an attempt has been made to bring together from a very limited number of sources facts concerning the development of the teacher of mathematics in the better secondary schools of different countries. A presentation which would be at all adequate and complete in its different aspects would require for each country a volume based upon a far wider range of sources of information. Here simply the descriptions of the few features which happen to be dealt with in available authorities are epitomized; there has been no opportunity for uniform treatment. It is therefore only in a very general way that definite statements may be made in comparing the methods of different countries.

Few will deny that if the secondary education in a country is of a high order, and is extended over a period of seven or eight years, it must materially contribute to the training of the pupil who, after further development in university or professional school, returns to the secondary school as teacher. It is therefore pertinent to inquire, What period is devoted to secondary education in different countries? To what extent is this based upon work of primary schools? When is primary instruction given in secondary schools? When does the pupil enter the university? Bearing in mind the types of schools which have been excluded from consideration in this report, and the fact that, in general, only the better secondary schools (under Government or State control) leading directly or indirectly to a university have been considered, fairly definite answers to all of these questions may be found in the accompanying synoptic table.

The age there given is the normal lower limit, and in any one of the countries it is possible for a pupil or student of the given age to be at the stage of scholastic advancement indicated. It should not be inferred, however, that this rate of progress is necessarily characteristic of the country; for example, in Japan the pupil just graduating from the middle school is usually nearer 20 than 17 years of age; and in Germany, while a small percentage of students are ready for a university career at 17 years of age, more than one-half are at least 19, and more than one-third not less than 20 years of age. In the following discussion I shall, however, use the normal age given in the table.

We remark that in 15 of the 18 countries the normal age of entering the university is 18 or 19. These countries are: Austria, Belgium, Denmark, England, Finland, France, Germany, Hungary, Italy, Netherlands, Roumania, Russia, Sweden, Switzerland, and the United States. When the extent of secondary school preparation for the university is considered, we find wide variation of custom. Australia and the United States are at the foot of the list with only 4 years; but 7 countries (Austria, Finland, Hungary, Italy, Japan, Roumania, and Russia) devote 8 years, and 3 countries (France, Germany, Sweden) 9 years to secondary education.

Since the period of school education leading to a university in 14 of the countries is 12 or 13 years, the wide difference of views which these countries hold with respect to the portion of this time which should be assigned to secondary education proper is interesting. On the one hand, the United States holds that during 8 of the years the methods of elementary education should be employed; while, on the other hand, France and Germany consider that best results are obtained when even the 3 or 4 years allotted to primary instruction are given in connection with secondary schools. It is, then, not surprising to find that there is great difference between the scholastic equipment of students coming from these two types of school. The graduates of the classe de mathématiques spéciales or of the German Gymnasium are about on a par with the youth who has finished his junior year in one of the better American colleges. And in other countries also, like Denmark, Japan, and Sweden, the graduate of a higher secondary school has done more or less work whose equivalent is done in colleges in the United States. It is only in the light of such considerations that the full force of, say, Sweden's requirement of 10 or 11 years of preparation before a graduate of a gymnasium may return as a regularly appointed professor can be adequately appreciated.

Again, it should be borne in mind that even with courses of secondary schools covering the same number of years the content may be vastly different. Contrast the 9 years of the German gymnasium, where 19.8 per cent of the time is devoted to mathematics, sciences, and drawing, and 34.2 per cent to ancient languages, with the 9 years of the French lycée in the science-modern language section and classes de mathématique spéciales with about 36.8 per cent of its course in mathematics, science, and drawing, and no time spent on ancient languages. France offers a much more extensive mathematical course in her secondary schools than does any other country in the world.

From such different types of schools come the future teachers of mathematics. Let us next consider in a general way how these teachers were prepared after leaving the secondary schools. Broadly speaking, the training is derived from: I. Courses in a university or similar institution; II. Professional training.

I. All the countries require some university training on the part of candidates for appointment as secondary school teachers.[1] The maximum requirements are in Denmark and Netherlands, each 6 years, and in Sweden about 8 years. On the other hand, for minor positions in the athénées of Belgium and regular positions in Canton Vaud, Switzerland (where most Cantons require 4 or 5 years), only 2 or 2½ years of attendance at a university are compulsory. The complete record is as follows: Australia (Victoria and New South Wales), 3 years; Austria, 3½ to 4; Belgium, 4 to 5, 2 for minor positions in athénées; Denmark, 6; England, 3 to 4; Finland, 4 to 5; France, not less than 3, in addition to 2 years in classes de mathématiques spéciales; Germany, 3 to 4, but rarely 3 and often 5 are taken; Hungary, 4; Italy, 4 or 5; Japan, 3; The Netherlands, 6; Roumania, not less than 3; Russia, 4; Spain, 5, for lower positions, 4; Sweden, usually 8; Switzerland, 4 to 5 years for the most part, in one or two cases 2 to 3; United States, 3 to 4.

Let us consider a single example, to bring out more clearly the implications of these statements. Since the future mathematical teacher entering a German university is about on a scholastic par with the student who has finished the junior year at a college in the United States, we may state, roughly, that the German teacher has generally had at least three years more of scientific training than the American teacher in a secondary school has had.

II. In addition to attendance at universities, some countries require professional training. Australia (Victoria and New South Wales), England (generally), Finland, Roumania, and some States of Germany each require one year (it is only in theory that Austria requires a year); other States of Germany and Denmark require two years each; in addition to a year in a Seminar, Sweden requires two years of probation as teacher before regular appointment and in a similar way Hungary requires three; and in Italy after four years of trial a teacher may be dropped. In France the professional training may possibly be estimated at half a year. In seven countries no professional training is made compulsory. These countries are: Belgium, Japan (in higher middle schools), the Netherlands, Russia, Spain, Switzerland, and the United States.[1] The question of the far greater efficiency of the training in some countries than in others is not taken up here.

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[1] As far as this statement concerns Japan, reference is made to the higher middle schools.

When the courses required for the candidates in different countries are considered, the unenviable conclusion is reached that Australia, England, and the United States are largely in a class by themselves. For in these countries mathematical teachers know practically nothing of their subjects, as they have had no special mathematical training in the universities. Perhaps England is less of an offender on account of the number of trained specialists necessary at schools preparing for Scholarship Examinations. All other countries require of their professors a more or less broad scientific training, and the minimum mathematical requirement is a knowledge of the differential and integral calculus. Most countries include also among their requirements differential equations, analytic geometry of three dimensions, descriptive geometry, projective geometry, mechanics, and physics. A doctor's degree is required of higher teachers in Belgium, Italy, Netherlands, Spain, and Sweden; and the standard for teachers in France and Germany is certainly not below that for the degree of doctor in those countries (indeed much of the training for teacher and doctor is identical).

In the American Report to the International Commission on the Teaching of Mathematics on *Training of Teachers of Elementary and Secondary Mathematics*, the following lines occur (p. 13):

> Yet with us, where the public is now beginning to recognize that teaching is a profession, a feeling which will certainly increase as the years go by, the time will undoubtedly come when secondary teaching will be sufficiently attractive financially to enable us to demand from the prospective teacher some such preparation as the following: On the side of pure mathematics we may expect the calculus, differential equations, solid analytic geometry, projective geometry, theory of equations, theory of functions, theory of curves and surfaces, theory of numbers, and some group theory. On the applied side we should demand a strong course in mechanics, theoretical and practical astronomy, descriptive geometry, and some mathematical physics with a thorough course in experimental physics.

We have seen that this ideal for the scientific training of teachers is *now* a matter of course in a number of countries.

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[1] The occasional requirements in Russia, Switzerland, and the United States are neglected. For most of the teachers in the middle schools of Japan a certain amount of training is demanded.

On the whole, the salary, pension, social position, and scholastic status of the secondary-school teacher in France and Germany seem to combine to give to the profession an attractiveness not to be found in other countries.

TABLE.

In this table it should be noted that: (1) The separation lines between the primary and secondary schools do not always indicate that regular primary instruction ends there, but only that portion of it preparatory to the secondary school in question; (2) five only, of the six years of the course in the realskola of Sweden, suffice as preparation for a gymnasium; and (3) some university courses extend beyond the limits of age in the table, e. g., in Belgium and in Japan.

Ages of pupils and classification of schools in different countries.

Ages.	Australia. (Victoria, N. S. Wales.)	Austria.		Belgium.		Denmark.
6- 7	Primary school......... I	Primäre Schule........ I	Primäre Schule........ I	École primaire......... I	École primaire......... I	Forskole............... I
7- 8	II	II	II	II	II	II
8- 9	III	III	III	III	III	III
9-10	IV	IV	IV	IV	IV	IV
10-11	V	Untergymnasium...... I	Unterrealschule........ I	V	V	V
11-12	VI	II	II	VI	VI	Mellemskole............ I
12-13	VII	III	III	Athénée royal....... VII	Lower middle school... I	II
13-14	State high school...... [1] I	IV	Oberrealschule....... IV	VI	II	III
14-15	II	Obergymnasium....... V	V	V	III	IV
15-16	III	VI	VI	IV	IV	Gymnasium............ I
16-17	IV	VII	VII	III	....	II
17-18	University............. I	VIII	....	II	....	III
18-19	II	University............ I	....	I	....	University............. I
19-20	III	II	....	University............. I	....	II
20-21	....	III	....	II	....	III
21-22	....	IV	....	III	....	....

Ages.	England.[2]	Finland.	France.	Germany.	
6- 7	Primary school...................... I	....	Lycée: Primary......Dixième.	Gymnasium: Vorschule............ I	Vorschule............ I
7- 8	II	Folkskola......... I	Neuvième.	(Realgymnasium, II	II
8- 9	III	II	Huitième.	Oberrealschule.) III	III
9-10	IV	[3] III	Septième.	Unterstufe... Sexta.[4]	Progymnasium....... I
10-11	Great public schools: Preparatory.. I	Lyceum.......... I	First cycle...Sixième.	Quinta.	(Realprogymnasi- II
11-12	(Grammar school, institute, etc.) II	II	Cinquième.	Quarta.	um, Realschule.) III
12-13	Junior.............. Form I	III	Quatrième.	Mittelstufe... Untertertia.	IV
13-14	Form II	IV	Troisième.	Obertertia.	V
14-15	Senior department.. Form III	V	Second cycle.Seconde.	Untersekunda.	VI
15-16	Form IV	VI	Première.	Oberstufe.... Obersekunda.	....
16-17	Form V	VII	Philos. et math.	Unterprima.	....
17-18	Remove.	VIII	Classe de math. spéciales prép.	Oberprima.	....
18-19	Form VI	University....... I	Classe de math. spéciales.	University.......................... I	....
19-20	University......................... I	II	University.......................... I	II	....
20-21	II	III	II	III	....
21-22	III	IV	III	IV	....

Ages.	Hungary.	Italy.		Japan.	The Netherlands.	
6-7	Volkschule I	Scuola elementare I	Scuola elementare I	Elementary school I	Primary school I	Primary school I
7-8	II	II	II	II	II	II
8-9	III	III	III	III	III	III
9-10	IV	IV	IV	IV	IV	IV
10-11	Gymnasium I	Ginnasio I	V	V	V	V
11-12	("Real school"). II	II	Scula tecnico I	VI	VI	VI
12-13	III	III	II	Middle school I	Gymnasium I	Higher burgher school I
13-14	IV	IV	III	II	II	II
14-15	V	V	Istituto tecnica I	III	III	III
15-16	VI	Liceo I	II	IV	IV	IV
16-17	VII	II	III	V	V	V
17-18	VIII	III	IV	Higher middle school I	VI	University I
18-19	University I	University I	University I	II	University I	II
19-20	II	II	II	III	II	III
20-21	III	III	III	University I	III	IV
21-22	IV	IV	IV	II	IV	....

Ages.	Roumania.		Russia.		Spain.	Sweden.
6-7	Primary school I	Primary school I	....	....	Colegio I	Elementary school I
7-8	II	II	Primary school I	Primary school I	II	II
8-9	III	III	II	II	III	III
9-10	IV	IV	III	"Real school" (prep.)[6] I	IV	Realskola I
10-11	Lycée: First cycle I	Gymnasium I	Gymnasium I	I	Instituto I	II
11-12	II	II	II	II	II	III
12-13	III	III	III	III	I	IV
13-14	IV	IV	IV	IV	II	V
14-15	Second cycle V	....	V	V	III	Gymnasium I
15-16	VI	....	VI	VI	IV	II
16-17	VII	....	VII	[6] VII	University I	III
17-18	VIII	....	VIII	University I	II	IV
18-19	University I	....	University I	II	III	University I
19-20	II	....	II	III	IV	II
20-21	III	....	III	IV	V	III
21-22	IV	....	V	....	....	IV

For footnotes see p. 230.

Ages.	Switzerland.[7]				United States.	
6- 7	Primary education	I	Primary education	I	Elementary school: Primary	I
7- 8		II		II		II
8- 9		III		III		III
9-10		IV		IV		IV
10-11	Gymnasium	I		V	Grammar	V
11-12	(Realschule.)	II		VI		VI
12-13		III	Gynasium	I		VII
13-14		IV	(Realschule.)	II		VIII
14-15		V		III	High schoo	
15-16		VI		IV		II
16-17		VII		V		III
17-18		VIII		VI		IV
18-19		IX		VII	University	I
19-20	University	I	University	I		II
20-21		II		II		III
21-22		III		III		IV

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[1] In Victoria most of the pupils entering the State high schools are 12 years of age; in New South Wales, 13.

[2] In England typical school programs do not exist, and the outline given here is simply that in use at some large schools. Norwood and Hope group the forms differently (*Higher Education of Boys in England*, pp. 297–298), I–IV constituting a lower course, V–VI a "specialist course," somewhat like the first and second cycles of the French lycées. It is generally believed that the proper time for a student to enter a university is when he is 18 or 19 years of age.

[3] According to the Report of the International Commission on the Teaching of Mathematics in Finland (pp. 5, 6, 21) there appears to be a gap between the primary and secondary courses. We are told that the normal age of a boy entering the lyceum is 10, and that the average age of the boy entering upon the two-year course of the preparatory school (École primaire élémentaire or École préparatoire) is 7.

[4] In Wurttemberg the nine classes of the secondary school are numbered I (the first) to IX (the last).

[5] In Russia there is no correlation between elementary and secondary curricula, and while there is nothing to prevent a clever boy whose parents can afford the necessary expense from passing from a primary school at the age of 10 or 11 into a gymnasium or "real school," it is unusual and often inadvisable. Hence many "real schools" introduce this preparatory year.

[6] The regular course of the "real school" was formerly six years, but this seventh year is now added in most cases.

[7] With the great variation of systems in the Cantons no very definite statement can be made with reference to the period covered by primary and secondary instruction. In the case of Gymnasien the period is usually 13 years, but some Cantons have 11-year and 14-year periods. In Realschulen the general range is 12½ years, though there are also those with 10½ and 11½ year range. Primary instruction for boys begins at 6 years of age in most of the Cantons, and the usual range of duration is 4 to 6 years. The term "Realschule" is employed to designate many types. For example, Gymnasium Biel, in Bern; Real section of Kantonschule in Schaffhausen; Collège de Genève; Ginnasio e Liceo in Tessen; and Collège et Gymnase in Vaud.

More details in this connection may be found in K. Brandenberger's report, pp. 14–25.

APPENDICES.

APPENDIX A.

ENGLAND.

CAMBRIDGE LOCAL EXAMINATIONS, SENIOR STUDENTS.

December, 1915.

GEOMETRY.

(Two hours.)

The answers to questions marked A *and* B *are to be arranged and sent up to the examiner in separate bundles.*
N. B.—*Attention is called to the alternative questions* B ix, B x, B xi *at the end of the paper.*

A.

A 1. In the triangles ABC, DEF, $\angle B = \angle E$, $\angle C = \angle F$, and $BC = EF$. Prove that the triangles are congruent.

Show that the diagonals of a parallelogram bisect each other.

A 2. In a triangle ABC, AD is drawn perpendicular to BC; show that, when the angle C is acute,

$$AB^2 = AC^2 + BC^2 - 2BC.DC.$$

Prove that the sum of the squares on the four sides of a parallelogram is equal to the sum of the squares on the diagonals.

A 3. From a point O outside a circle two straight lines OPQ, ORS are drawn, the first cutting the circle at P and Q, the second cutting the circle at R and S. Prove that

$$OP.OQ = OR.OS.$$

In the triangle ABC, the angle A is a right angle. From a point D on BC a line DEF is drawn perpendicular to BC, meeting AC at E, and BA produced at F. Show that

$$DE^2 = BD.DC - AE.EC.$$

A 4. Inscribe a regular octagon in a circle of radius 2 inches. Produce alternate sides of the octagon, so as to form a square.

Measure the side of the square.

Show clearly all the construction lines in your figure.

B.

B 5. Show that if a straight line touch a circle, and from the point of contact a chord be drawn, the angles which this chord makes with the tangent are equal to the angles in the alternate segments.

Two circles intersect at A and B. At A, tangents to the circles are drawn, meeting the other circles at X and Y. Show that BA bisects the angle XBY.

B 6. Two triangles ABC, DEF are similar, AB and DE being corresponding sides. Show that their areas are in the ratio $AB^2 : DE^2$.

Through each of two opposite corners of a rectangle perpendiculars are drawn to the diagonal which joins the other two corners. Show that if the three parts into which the diagonal is thus divided are equal, the squares on the sides of the rectangle are in the ratio 2 : 1.

B 7. The tangents to a circle at P and Q meet in T, and C is the center of the circle. TC meets the circle at A and B, and meets PQ at X.

Show that $CX.CT=CA^2$ and that $AX\ .\ XB=TA\ :\ TB$.

B 8. Two circles (not in the same plane) intersect in two points. Show how to obtain the center of the sphere on which both circles lie.

A, B, C, D, E, F are six distinct points in space, such that A, B, C, D lie on a circle, C, D, E, F lie on a circle, E, F, A, B lie on a circle, no two of the circles lying in the same plane. Show that the three circles lie on a sphere.

N. B.—*One or more of the following questions* B ix, B x, B xi *may be taken instead of an equal number of the questions* B 5, B 6, B 7, B 8, *but lower marks will be assigned to them.*

B ix. Show that the sum of the angles of a triangle is equal to two right angles.

ABC is an acute-angled triangle, and O is the center of the circle which passes through A, B, C. Show that the angles OBC and BAC are complementary.

B x. Illustrate and explain by means of a figure the geometrical theorem corresponding to the algebraical identity

$$(a+b)^2=a^2+2ab+b^2.$$

$ABCD$ is a square; points E, F, G, H are taken on AB, BC, CD, DA such that $AE=BF=CG=DH=\frac{1}{4}$ of the side of the square. Show that the area of the square $EFGH$ is $\frac{5}{8}$ of the area of the square $ABCD$.

B xi. Draw two perpendicular lines AB, BC. Make $AB=1\frac{1}{2}$ inches, $BC=2\frac{1}{4}$ inches. Construct a circle to pass through C and to touch AB at A. Measure the radius of this circle.

Show clearly all the construction lines in your figure.

ALGEBRA.

(Two hours and a half.)

Squared paper and tables of logarithms, etc., can be obtained from the presiding examiner.
N. B.—Attention is called to the alternative questions A, B, C *at the end of the paper.*

1. Show that $\left\{\dfrac{4x^2}{(x+1)^2}-1\right\}\left\{\dfrac{4x^2}{(x-1)^2}-1\right\}=\dfrac{8x^2}{x^2-1}+1.$

2. Find the factors of

$$\text{(i)}\quad a^2b-b^3+abc-b^2c,$$
$$\text{(ii)}\quad x^4-a^2x^2+2abx-b^2;$$

and show that if $a+b+c=0$,

$$a^3+b^3+c^3=3abc.$$

3. Solve the equations:

$$\text{(i)}\quad \begin{cases}\dfrac{p}{x}+\dfrac{q}{y}=1,\\[2ex] \dfrac{q}{x}+\dfrac{p}{y}=1,\end{cases}$$

$$\text{(ii)}\quad \begin{cases}(x-2)\ (y-3)=3,\\ (x-3)\ (y-2)=4.\end{cases}$$

4. A room is such that its length is 10 feet more, and its height 13 feet less, than its breadth. If it had been 1 foot less each way, it would have contained 1,524 cubic feet less. Find its dimensions.

5. Find by logarithms the value of $\dfrac{1.658\times(.0247)^{\frac{1}{3}}}{(9.892)^{\frac{2}{3}}}.$

In what year must £1 have been put out at compound interest at 5 per cent per annum to amount to £100 at the end of 1915?

6. Show how to obtain the formula for the summation of n terms of a geometric progression.

If the first term is 9 and the ratio of the sum of eight terms to the sum of four terms is 97 : 81, find the series.

7. If A is the arithmetic, G the geometric, H the harmonic mean, between two numbers, show that $AH = G^2$ and that $A > G > H$.

If

$$\left.\begin{aligned} A-G&=\tfrac{1}{2} \\ G-H&=\tfrac{12}{25} \end{aligned}\right\},$$

find the numbers.

8. Find the condition that $ax^2+2bx+c$ has always the same sign for all real values of x.

Show that, if $\quad x^3+px+q=0$

and $\quad x^3+qx^2+p=0$

have a common root, either

$$p+q=-1 \text{ or } (p-q)^3=-q^2(p^2-pq+q^2).$$

9. Find the number of different pairs (irrespective of order) that can be formed with $2n$ things.

If, of 14 numbered cards, 5 are red, 6 white, and 3 blue, find the number of groups of three, one of each color, that may be formed.

How many more groups can be formed if any two, but only two, may be of the same color?

10. Enunciate the binomial theorem, and write down the middle term in the expansion of $\left(1-\dfrac{x}{2}\right)^{12}$.

Find the term independent of x in the expansion of

$$\left(x+1+\frac{1}{x}+\frac{1}{x^2}\right)^5.$$

11. Plot the graph

$$y=\frac{x^3}{8}-\frac{3x^2}{2}+\frac{11x}{2}-4 \text{ from } x=1 \text{ to } x=7,$$

and find its gradients when $x=2$, when $x=4$, and when $x=6$.

Draw the tangent at the point (4, 2).

12. Plot the graph $4y=8+5x-3x^2$ from $x=-2$ to $x=3$, and show by integration that the area of the portion on the positive side of the axis of x is $(\frac{11}{6})^3$.

N. B.—*Any of the following questions may be taken instead of an equal number of the questions* 8, 9, 10, 11, 12, *but considerably lower marks will be assigned to them.*

A. Solve the equation:

$$\frac{a\,(x+a)}{b}-\frac{b\,(x-b)}{a}=a+b.$$

B. A cask is filled with wine and water in the proportion of 3 : 1; 4 gallons are drawn off, and the cask filled up with water. If the proportion of wine to water is now 3 : 2, find how many gallons the cask can hold.

C. Divide $a^2(b+c^{-1})+b^2(c^{-1}+a)-c^{-2}(a+b)+abc^{-1}$ by $a+b-c^{-1}$.

TRIGONOMETRY.

(One hour and a half.)

Squared paper and tables of logarithms, etc., can be obtained from the presiding examiner.

N. B.—*Attention is called to the alternative questions* A, B *at the end of the paper.*

1. (*a*) Find to the nearest minute the angle which an arc of length 4 inches subtends at the center of a circle whose radius is 5 inches.

(*b*) Find by drawing and measurement the least positive angle whose tangent is -1.2; and calculate the cosine of this angle, correct to three significant figures.

(*c*) The length of the slant side of a cone is 4.3 inches, and the angle at the vertex is 115°. Calculate the height of the cone correct to a tenth of an inch.

2. Determine, by drawing the graph of $\sin x+2\cos x$ for values of x between 0° and 45°, the value of x between these limits for which $\sin x+2\cos x$ is a maximum.

3. Prove that

$$(a)\ \cos A-\cos B=-2\sin\frac{A+B}{2}\sin\frac{A-B}{2},$$

$$(b)\ \cos(A-B)\,[1+\sin(A+B)]=(\sin A+\cos B)\,(\cos A+\sin B).$$

4. Find the length of the side AB of the triangle ABC, given that

$$BC=23.4\text{ inches},\quad \angle ABC=42^\circ,\quad \angle ACB=67^\circ.$$

5. An airship is sighted at the same time from two points A and B at the same level 1 mile apart. It is due south of A at an elevation of 34° and due east of B at an elevation of 23°. Calculate its height in feet.

6. (*a*) Write down all the cube roots of $\cos\theta+\sqrt{-1}\sin\theta$.

(*b*) Separate into real and imaginary parts the expression

$$\frac{1+\sqrt{-3}}{(1+\sqrt{-1})^{\frac{1}{3}}}$$

7. (*a*) Express $\tan(\theta_1+\theta_2+\theta_3+\theta_4+\theta_5)$ in terms of $\tan\theta_1$, $\tan\theta_2$, $\tan\theta_3$, $\tan\theta_4$, $\tan\theta_5$.

(*b*) Prove that, if $\tan\alpha$, $\tan\beta$, $\tan\gamma$ are the roots of the equation $x^3+ax^2+x+b=0$, where a, b are unequal, then $\alpha+\beta+\gamma$ is an odd number of right angles.

N. B.—*Either of the following questions may be taken instead of either of the questions 6, 7, or both may be taken instead of the two questions 6, 7, but considerably lower marks will be assigned to them.*

A. A is the foot of a flagstaff AB, and C is a point on it such that $AC=\frac{1}{4}AB$. If the flagstaff subtends an angle of 48° at a point X on the ground, calculate the value of $\tan BXC$.

B. (*a*) Find all the solutions of the equation $\sin 3\theta+\cos\theta=0$.

(*b*) Prove that $\cot\frac{\theta}{2}-\cot\theta=\operatorname{cosec}\theta$.

ANALYTIC GEOMETRY AND CALCULUS.

(*Two hours.*)

ANALYTIC GEOMETRY.

Tables of logarithms, etc., may be obtained from the presiding examiner.

1. The corners of a triangle are the points (2, 3), (3, 8), (−1, 5). Find the tangent of the angle at (2, 3).

2. Find the equation of the two bisectors of the angles formed by the two straight lines $ax^2+2hxy+by^2=0$.

The straight line $3x+2y=1$ meets the circle $x^2+y^2=8$ in two points P and Q. Find the equation of the straight lines joining P and Q to the origin.

3. Obtain an expression for the length of the tangent from the point (x', y') to the circle $x^2+y^2+2gx+2fy+c=0$.

A point P moves so that the tangents from it to the two circles

$$x^2+y^2=4$$

and

$$x^2+y^2+6x-8y+3=0$$

are in the ratio 3 : 2. Find the equation of the locus of P.

4. Find the equation of the polar of the point (x', y') with respect to the parabola $y^2=4ax$.

P is a variable point on any fixed line at right angles to the axis of the parabola. From P a perpendicular is drawn to its polar, meeting it in Q. Prove that the locus of Q is a circle with its center at the focus.

5. Find the condition that the line $y=mx+c$ may be (i) a tangent, (ii) a normal to the ellipse

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1.$$

If the tangent and normal at any point P of the ellipse meet the major axis in T and T', so that $TT'=a$, prove that the eccentric angle, ϕ, of P, is given by the equation

$$e^2\cos^2\phi+\cos\phi-1=0,$$

where e is the eccentricity.

CALCULUS.

6. Obtain the values of

$$\frac{d\sqrt{x}}{dx},\quad \frac{d}{dx}\sin x,\quad \int\frac{dx}{\sqrt{a^2-x^2}},\quad \int_{-1}^{1}(x^3+2x^2)\,dx.$$

Prove that $y=A\cos 2x+B\sin 2x+Ce^x$ satisfies the differential equation

$$\frac{d^3y}{dx^3}-\frac{d^2y}{dx^2}+4\frac{dy}{dx}-4y=0.$$

7. A hollow cone, of height 20 inches and radius at the base 10 inches, is inverted, and water is poured into it at the rate of 12 cubic inches per second. At what rate is the area of the water-surface increasing when the depth of the water in the cone is 15 inches?

8. A circle of radius 6 inches is divided into two segments by a chord at a distance of 1 inch from the center. Prove that the rectangle of greatest area which can be inscribed in the smaller segment has an area of 27.8 square inches approximately.

9. The curve $y=x^3$ meets the line $y=4x$ in three points. Find the coordinates of these points and obtain the equation of the normal to the curve at each of them.

If P is the one whose abscissa is greatest, find the area contained by the y-axis, the normal at P, and the curve from the origin to P.

Applied Mathematics.

(*Two hours.*)

Squared paper and tables of logarithms, etc., can be obtained from the presiding examiner.
The acceleration due to gravity may be taken as 32 foot-second units.

1. Three forces of 30 pounds, 50 pounds, 90 pounds act at a point, the angle between the directions of any two forces being 120°. Find the magnitude of their resultant, and the angle which its direction makes with the greatest force.

2. Prove that the algebraic sum of the moments of two concurrent forces about any point in their plane is equal to the moment of their resultant about the same point.

Forces $2P$, P, P act along BC, CA, AB, the sides of an equilateral triangle ABC. Show that the resultant is a force P parallel to BC and at a distance from it, on the side remote from A, equal to the height of the triangle.

3. Two light rods AC (2 feet long), BC (3 feet long) are hinged to one another at C and to fixed points at A and B, the plane of the rods being vertical. The horizontal distance between A and B is 4 feet, and A is 1 foot higher than B, and C is above AB. From C is suspended a weight of 10 pounds. Find by graphical construction or otherwise the thrusts in the rods.

4. A body is placed on a rough plane inclined to the horizontal at an angle α. Show that it can remain in equilibrium if the coefficient of friction is greater than $\tan\alpha$.

A circular hoop of weight W hangs in a vertical plane over a rough peg. Prove that the greatest weight which can be suspended tangentially from the rim of the hoop without causing the latter to slip is $W\frac{\sin\epsilon}{1-\sin\epsilon}$, where ϵ is the angle of friction.

5. A steamer is moving along a narrow canal when a man steps ashore after walking across the deck in a line making an angle of 60° with the line from stern to bow. He finds himself 25 feet farther along the canal than if he had stepped off on the other side before walking across. If the vessel is moving at 2 miles per hour and the deck is 25 feet wide, how fast did the man walk?

6. Prove the formula $s=ut+\frac{1}{2}ft^2$.

A mass of 35 pounds is pulled up a rough plane of inclination 1 in 16 by a rope parallel to the plane whose tension is 150 poundals. If the resistance due to friction is 12 poundals, find the velocity acquired by the mass in 10 seconds.

7. A body is projected with velocity V in a direction making an angle α with the horizontal. Find the greatest height that it reaches and its horizontal range.

Find, in foot-pounds, the least energy of projection which must be given to a ball of 3 ounces in order that it may have a horizontal range of 300 yards.

8. A particle moves in a straight line with an acceleration directed toward a fixed point in the line and equal to μ times the distance of the particle from the point. Show that the motion is periodic, with period $2\pi/\sqrt{\mu}$.

OXFORD AND CAMBRIDGE SCHOOLS EXAMINATION BOARD.

EXAMINATION FOR SCHOOL CERTIFICATES.

July, 1910.

ARITHMETIC.

(*Two hours.*)

1. Find the number nearest to 9,999 that can be divided exactly by 3, 4, 5, 7.

2. Simplify $\frac{2}{3}(1\frac{5}{6}-\frac{1}{2}+\frac{3}{4})+\frac{1}{2}(\frac{1}{3}-\frac{3}{4}\text{ of }1\frac{5}{9})$.

Divide .003125 by .02048, obtaining the answer correct to three decimal places.

3. Find the cost of 3 tons 7 cwt. 2 qrs. 11 lb. at £4 8s. 8d. per cwt.

4. If it costs 6 dollars 30 cents to carry 4½ cwt. a distance of 500 miles, find, to the nearest cent, the cost of carrying 8 cwt. 360 miles.

5. A bankrupt owes £6,000. He pays 12s. 6½d. in the £, and defrauds his creditors by concealing $\frac{1}{10}$ of his assets. Find the value of his estate.

6. Find to the nearest penny, the compound interest on £2,525 at 2½ per cent per annum for four years.

7. A square field contains 2 acres 3 roods, and is to be fenced with hurdles 6 feet in length. What is the smallest number of hurdles that can be used for each side of the field?

8. A rectangular tank is 35 cms. deep, 62 cms. long, and 27 cms. wide. If the tank is filled with water, how many times could a bucket holding 8.5 liters be filled from it, and what would remain over?

9. A man buys oranges at 5s. a hundred and sells them at 8d. a dozen. What is his gain or loss per cent?

10. A man wishes to obtain £1,000 by selling 2½ per cent consols at 82½. What amount of stock must he sell, and what would be the quarterly income derived from it? (Answers correct to the nearest penny.)

ALGEBRA.

(*Two hours.*)

NOTE.—(1) *In order to pass in elementary mathematics candidates must satisfy the examiners in Part I.*

(2) *In order to pass in additional mathematics candidates must satisfy the examiners in Parts I and II taken together.*

(3) *Candidates for exemption from the army qualifying examination must satisfy the examiners in Parts I and II, taken together, and should* NOT *attempt the questions* A, B, C, D.

Part I.

1. If $a = 2$, $b = -3$, $c = 0$, $d = \frac{1}{2}$, find the value of

$$\frac{(2a + b)(c + 4d)}{a + b} + cd.$$

2. Find the continued product of $b - c$, $c - a$, $a - b$.

Divide $4x^4 - 9x^2 + 6x - 1$ by $2x^2 + 3x - 1$.

3. Simplify:

$$(1)\ \frac{3}{x - 1} - \frac{2}{x + 2} - \frac{x + 3}{x^2 + x - 2};$$

$$(2)\ \frac{\frac{a}{b} - \frac{b}{a}}{\frac{a^3}{b} - \frac{b^3}{a}} + \frac{a + b}{\frac{a}{b} + \frac{b}{a}}.$$

4. Prove that the L. C. M. of two quantities is equal to their product divided by their H. C. F.

Find the H. C. F. of

$$x^5 + x^4 + x^3 + x^2 + x + 1 \text{ and } x^3 + x^2 - x + 2.$$

5. Solve the equations:

$$(1)\ \tfrac{1}{3}(x - 2) - \tfrac{2}{5}(x + 2) = \tfrac{1}{7}(x - 6) + \tfrac{2}{105};$$

$$(2)\ \frac{x^2 + 1}{x} = \frac{x + 5}{3}.$$

6. The difference of two fractions, one (the greater) formed by adding a certain number to both the numerator and the denominator of $\frac{5}{9}$, the other (the lesser) formed by subtracting this number from both the numerator and the denominator of $\frac{5}{9}$, is $\frac{1}{3}$. Find the number.

The following questions, A B, C, D *are to be attempted* ONLY *by candidates who do* NOT *attempt* PART II.

A. Factorize:

$$(1)\ 6x^2 + x - 12;$$

$$(2)\ a^2 + b^2 - c^2 - 2ab.$$

B. Solve the equations:

$$ax - by = a^2 + b^2,\ x + y = 2a.$$

C. Show that the sum of the squares of three consecutive integers is greater by 5 than 3 times the product of the greatest and the least.

D. Solve *graphically* the equations:

$$\tfrac{1}{7}x + \tfrac{1}{4}y = 1.2, \quad 4x = 5y.$$

[Take 1 inch as your unit.]

Part II.

7. Solve the equations:

$$y^2 = 5x + 1, \quad 3x = 2y + 1.$$

8. If $\frac{a + b}{a - b} = \frac{c + d}{c - d}$, prove that $\frac{a}{b} = \frac{c}{d}$.

If a, b, c are in continued proportion, prove that

$$\frac{a - b}{b - c} = \left(\frac{a}{c}\right)^{\frac{1}{2}}.$$

9. Find the value of

$$(34.97)^{.3} + (1.08)^{7.3}.$$

Obtain a formula for the sum of 27 terms of the series

$$1 + .9 + .81 + .729 + .6561 + \ldots,$$

and show that the sum is very nearly 9.42.

10. Draw the graphs of $2y - x = 3$, $y = 3 - x^2$ for values of x lying between -1 and 4.

Find their gradients when $x = 1$, and show that the lines cut at right angles at the point (1, 2).

GEOMETRY.

(*Two hours.*)

NOTE.—(1) *In order to pass in elementary mathematics, candidates must satisfy the examiners in* α.

(2) *In order to pass in additional mathematics or to obtain exemption from the army qualifying examination, candidates must satisfy the examiners in* α *and* β *taken together.*

(3) *Figures should be drawn accurately with a hard pencil, and all "constructions" clearly shown.*

α

1. Draw a triangle ABC having BC=3 in., ABC=32°, and ACB=105°. Construct the bisector of the angle BAC meeting BC in D. Measure BD.

2. Draw a circle of radius 1 inch and take a point P 2.5 inches from its center. Construct a circle of radius 1.3 inches to touch the former circle and also pass through P.

3. If two triangles have two sides of the one equal to two sides of the other, and also the angles contained by those sides equal, prove that the triangles are congruent.

If the sides AB, AC of a triangle are equal, and equal lengths AE, AD are cut off on AB, AC, prove that CE, BD are equal.

4. State an axiom relating to parallel straight lines, and use it to prove that when a straight line crosses two parallel straight lines it makes alternate angles equal.

Prove that the opposite angles of a parallelogram are equal to one another.

5. Prove that the square on a side of a triangle opposite to an obtuse angle is greater than the sum of the squares on the other two sides by twice the rectangle contained by one of these two sides and the projection on it of the other.

6. Prove that the opposite angles of any quadrilateral inscribed in a circle are supplementary.

Two circles intersect in A, B. C, D are any two points on one circle and CA, DB cut the other circle in P, Q, respectively. Prove that PQ is parallel to CD.

β

7. Prove that the tangent at any point of a circle and the radius through the point are perpendicular to one another.

Two circles whose centers are A and B touch externally at C. The common tangent at C meets another common tangent in D. Prove that ADB is a right angle.

8. Construct a mean proportional to two given straight lines, and prove the construction.

$ABCD$ is a rectangle such that the square on AD is twice the square on AB. BE is drawn at right angles to AC to meet AC in E. Prove that AE is one-third of AC.

9. If two triangles have one angle of the one equal to one angle of the other and the sides about these equal angles proportional, prove that the triangles are similar.

10. Draw a straight line 5 inches long and divide it into three parts proportional to 37 : 46 : 53.

ELEMENTARY TRIGONOMETRY.

(Two hours.)

1. Define the tangent of an angle.

Construct an acute angle whose sine is .6, and find its cosine and its **cotangent.**

2. Prove that $\cos(180^\circ - a) = -\cos a$.

Arrange the angles a, β, γ in order of magnitude, if

$$\sin a = .8211,\ \cos\beta = .7738,\ \tan\gamma = -0.6104,$$

the angles being positive and each less than 180°.

3. What is the length of the shadow of a man 5 ft. 8 in. high cast by the sun when its altitude is 55° 30′ ?

4. Draw the graph of $10+10\cos 2x$ for values of x between 0° and 60°. Find a value of x to satisfy the equation

$$x = 10 + 10\cos 2x^\circ.$$

[Take one-tenth of an inch as unit along both axes.]

5. Prove that in *any* triangle

$$\frac{\sin A}{a} = \frac{\sin B}{b}.$$

If $A=63^\circ$, $B=49^\circ$, $a=50$ in., find b to the nearest tenth of an inch.

6. Prove that:

(1) $$\frac{\cos\theta+\sin\theta}{\cos\theta-\sin\theta} + \frac{\cos\theta-\sin\theta}{\cos\theta+\sin\theta} = \frac{2}{1-2\sin^2\theta};$$

(2) $$(\sec\theta+\tan\theta)(\operatorname{cosec}\theta-\cot\theta) = (\operatorname{cosec}\theta+1)(\sec\theta-1).$$

7. If $2\sin\theta + 5\cos\theta = 5$, prove that

$$\tan\theta = 0 \text{ or } \tfrac{20}{21}.$$

8. Prove that $\sin(A-B) = \sin A\cos B - \cos A\sin B$, where A and B are both acute angles and A is greater than B.

Prove that $\dfrac{\sin 5A+\sin A}{\sin 3A-\sin A} = 1 + 2\cos 2A$.

9. Show that in any triangle ABC

$$\frac{b+c}{a} = \frac{\cos\frac{1}{2}(B-C)}{\sin\frac{1}{2}A}.$$

If $b+c=24.8$ cm., $a=11.89$ cm., $A=39^\circ$, find B and C.

10. A lighthouse is observed from a ship which is steaming due N. to bear 62° W. of N.; after the ship has sailed 10 miles, the lighthouse is observed to bear 40° W. of S. Calculate the distance of the ship from the lighthouse when it was nearest to it.

STATICS AND DYNAMICS.

(Two and a half hours.)

[Assume $g=32$ for foot-second units.]

1. State and prove the triangle of forces.

Find graphically, or otherwise, the resultant of the following forces acting at a point viz, 5 lb. due N., 10 lb. 30° S. of W., 15 lb. 60° N. of E., 12 lb. SE. [Scale 1 cm. to 1 lb.]

2. A form 10 ft. long weighs 2 stone; its legs are 1 ft. from each end. A boy weighing 8 stone sits 2 ft. from one end, another weighing 7 stone sits 3 ft. from the other end. Find the pressures of the legs of the form on the ground.

3. Prove that, if three coplanar forces which are not parallel are in equilibrium, their lines of action meet in a point.

A stiff light rod ABC, bent so that ABC is a right angle and pivoted to a fixed point at A, has a weight of 12 lb. attached to it at C and is maintained with AB vertical and BC horizontal by a horizontal string attached at C. If the tension of the string is equal to the weight of 8 lb. and BC is 4 in., prove that AB is 6 in.

4. O is the center of a rectangular piece of cardboard $ABCD$; the piece AOB is cut out and then fitted to and gummed on to DC so that AB lies along DC. Find the center of gravity of the cardboard in its new form.

5. A mass of 14 lb. rests on a rough plane inclined at 30° to the horizon. If the coefficient of friction is .8, find the least force which, acting directly down the plane, will just move the mass.

6. Prove the formula $v^2=2fs$ for uniformly accelerated motion.

A point moving in a straight line with uniform retardation describes 7 ft. in the fifth second of its motion and 5 ft. in the seventh second. Prove that it will be at rest at the end of 11½ seconds.

7. Define *force* and show how it is measured.

Find (1) in poundals, (2) in pounds' weight the force which will bring to rest in 8 seconds a mass of 3 lb. moving at the rate of a mile a minute.

8. Explain the meaning of the terms *work*, *energy*, and *power*.

Find the number of foot-pounds of work done by a man who picks up a stone weighing half a pound and throws it through a window 20 ft. above the ground so that it passes through the window with a velocity of 8 ft. per second.

9. A bullet is fired with a velocity whose horizontal and vertical components are 200 ft. per second and 40 ft. per second, respectively. Find the greatest height to which it will rise and its distance from the firing point when it reaches the ground again.

Trigonometry, Statics and Dynamics.

(MATHEMATICS I.)

(Three hours.)

[Assume $g=32$ for foot-second units.]

1. Draw the graph of $5 \cos x$ for values of x from 0° to 60°; and employ it to find the angle whose cosine is .8.

2. Prove that $\sin^2 A=1-\cos^2 A$.

Prove that

$$(\sin A+\sin B)\,(\cos B-\cos A)=\sin(A-B)\,[1-\cos(A+B)].$$

3. Show that in any triangle:

(1) $b=c \cos A+a \cos C$;

(2) $\tan \frac{1}{2}A=\sqrt{\frac{(s-b)\,(s-c)}{s\,(s-a)}}$.

If $b=60$ ft., $c=72$ ft., $B=52°$, find the possible values of C.

4. Two men at A and B observe a balloon situated at a point vertically above the line AB (which is horizontal) and between A and B; the angles of elevation of the balloon are observed to be 68° 12′ and 78° 41′, and the distance AB is 240 ft. Show that the height of the balloon is nearly 400 ft.

5. State and prove the triangle of forces.

Find graphically, or otherwise, the resultant of the following forces acting at a point, viz, 5 lb. due N., 10 lb. 30° S. of W., 15 lb. 60° N. of E., 12 lb. SE. (Scale 1 cm. to 1 lb.)

6. A form, 10 ft. long, weighs 2 stone; its legs are 1 ft. from each end; a boy weighing 8 stone sits 2 ft. from one end, another weighing 7 stone sits 3 ft. from the other end. Find the pressures of the legs of the form on the ground.

7. Prove that if three coplanar forces, which are not parallel, are in equilibrium their lines of action meet in a point.

A stiff light rod ABC, bent so that ABC is a right angle and pivoted to a fixed point at A, has a weight of 12 lb. attached to it at C and is maintained with AB vertical and BC horizontal by a horizontal string attached at C. If the tension of the string is equal to the weight of 8 lb. and BC is 4 in., prove that AB is 6 in.

8. A mass of 14 lb. rests on a rough plane inclined at 30° to the horizon. If the coefficient of friction is .8, find the least force which, acting directly down the plane, will just move the mass.

9. Prove the formula $v^2=2fs$ for uniformly accelerated motion.

A point moving in a straight line with uniform retardation describes 7 ft. in the fifth second of its motion and 5 ft. in the seventh second. Prove that it will be at rest at the end of 11½ seconds.

10. Define force and show how it is measured.

Find (1) in poundals, (2) in pounds' weight the force which will bring to rest in 8 seconds a mass of 3 lb. moving at the rate of a mile a minute.

11. A body is attached to a fixed point by a string. If the body is let go when the string is taut and horizontal, prove that when the body is passing through its lowest position the tension of the string is three times the weight of the body.

ARITHMETIC, ALGEBRA, GEOMETRY, AND GEOMETRICAL DRAWING.

(MATHEMATICS I.)

(Three hours.)

1. Three bells begin tolling together at the rates of 50, 55, and 65 times per minute, respectively. How soon will they next toll together?

2. Having given that 1 cubic centimeter of water weighs 1 gram, that

$$1 \text{ kilogram}=2.2046 \text{ lbs.}$$
$$\text{and } 1 \text{ foot}=30.48 \text{ cms.},$$

find the weight of 1 cubic foot of water to the nearest ounce.

3. Solve the equations:

$$(1)\ (x^2-1)(x+2)=x^3;$$
$$(2)\ x-y=a,$$
$$x^2-ax+by=0.$$

4. Interpret the expressions $a^{\frac{1}{2}}$, a^{-2}, and justify your interpretation.

Simplify $\sqrt[3]{a^{-2}b^2c^{\frac{1}{2}}}\div(a^{-4}b^{-3}c^{\frac{1}{3}})^{\frac{1}{4}}$

5. Find the sum of n terms of an arithmetic progression, whose first term and common difference are given.

Prove that, if n is an odd number, the sum of n terms of the progression is n times the middle term.

Find the fifth term and the sum of 5 terms of the progression

$$\sqrt{2}+1,\ 1,\ \sqrt{2}-1\ \ldots\ .$$

6. Draw the graphs of the equations

$$x+y=1,\ y(1-x)=1$$

for the values of x between -2 and 3.

Show that the second curve has equal gradients at the two points where it is cut by the first.

7. Prove that the opposite angles of any quadrilateral inscribed in a circle are supplementary.

Two circles intersect in A, B. C, D are any two points on one circle and CA, DB cut the other circle in P, Q, respectively. Prove that PQ is parallel to CD.

8. Construct a mean proportional to two given straight lines and prove the construction.

ABCD is a rectangle such that the square on *AD* is twice the square on *AB*. *BE* is drawn at right angles to *AC* to meet *AC* in *E*. Prove that *AE* is one-third of *AC*.

9. If two triangles have one angle of the one equal to one angle of the other and the sides about these equal angles proportional, prove that the triangles are similar.

10. Draw a straight line 5 inches long and divide it into three parts proportional to 37:46:53.

UNIVERSITY OF LONDON.

MATRICULATION EXAMINATIONS, JANUARY, 1916.

ARITHMETIC AND ALGEBRA.

Tuesday, January 11—Morning, 10 to 1.

1. Find x from the equation

$$x=635-1540\times(.642)^2.$$

If .642 denotes a number lying between .6415 and .6425, what are the extreme values of x? Give all the required values of x to three significant figures.

2. A consumer receives notice at the end of a quarter that the charge per unit of electricity supplied is to be raised p per cent. In the next quarter he succeeds in reducing the number of units consumed by q per cent. Give a formula for the percentage increase in the bill for the quarter.

If $p=10$, and the bill is *decreased* by $6\frac{1}{2}$ per cent, find q.

3. There are two kinds of floorcloth of the same pattern, one 27 inches wide costing 2s. 6d. per yard length, the other 45 inches wide costing 7s. 6d. per yard length. A lady requires 24 square yards of floorcloth altogether and buys as much as she can of the wider kind, but is determined not to spend more than £5. What length of the wider kind will she be able to buy?

4. Resolve into factors

$$\text{(i)}\quad x^2+2x-y^2+2y,$$

$$\text{(ii)}\quad a^2-ab-3a+2b+2,$$

and simplify the expression

$$a^4-3(a-1)^4+3(a-2)^4-(a-3)^4.$$

5. If $x=\dfrac{ay+1}{a+y}$, $y=\dfrac{ab+1}{a+b}$, and $b=\dfrac{ac+1}{a+c}$, express x in terms of a and c, and check the result by putting c equal to unity.

6. Solve the equations

$$\text{(i)}\quad \frac{1}{3}\left(x-\frac{1}{2}\right)+\frac{1}{2}\left(x+\frac{1-x}{4}\right)=\frac{1}{6}\left(1+\frac{x+1}{8}\right),$$

$$\text{(ii)}\quad \left.\begin{aligned}(x-3)(x-4)&=(y-2)(y-6)\\ x+y&=9\end{aligned}\right\}.$$

7. (i) If $3x^2+12xy+8y^2+12x-10y-63=0$, find y when $x=7$.

(ii) Find the values of $\dfrac{1}{63\pm\sqrt{3957}}$ each correct to three significant figures.

8. Draw graphs of the equations

$$\text{(i)}\quad y=27-10x+x^2,$$

$$\text{(ii)}\quad y=12x-29-x^2.$$

For what values of x is $27-10x+x^2$ less than $12x-29-x^2$?

9. A sum of £1,000 is set aside at the end of each year and invested at 5 per cent compound interest. Find approximately the total sum accumulated at the end of 19 years, including the £1,000 set aside at the end of the nineteenth year.

[Use which you require of the following:

$$(1.05)^{18}=2.406619 \quad (1.05)^{19}=2.526950 \quad (1.05)^{20}=2.653298.]$$

10. *A* and *B* could between them type 4,500 pages of manuscript in 100 working hours, and undertook to do so. After 36 working hours *B* was replaced by *C*, and the first half of the task was completed in 54 working hours from the start. After 80 working hours from the start *B* returned, and all three just finished the task in time. Find the average number of pages typed in an hour by *A*, by *B*, and by *C*.

GEOMETRY.

Tuesday, January 11—Afternoon, 2.30 to 5.30.

1. Prove that, if two sides of a triangle are unequal, the angle opposite the greater side is greater than the angle opposite the less. Also, state and prove the converse of this theorem.

In an acute-angled triangle ABC in which AB is greater than AC, the lines drawn from B, C perpendicular to the opposite sides intersect in O. Prove that OB is greater than OC.

2. Prove that the diagonals of a rhombus bisect each other at right angles.

The side BC of a rhombus $ABCD$ is produced through C to a point E so that CE is greater than BC. The line ED is drawn and produced to cut CA produced in F, and F is joined to B. Prove that the angles BFA, EFA are equal.

3. Prove that parallelograms on the same base and between the same parallels are equal in area.

$ABCD$, $AEFG$ are two parallelograms having a common point at A, and having the vertex E on BC, and the vertex D on FG. Prove that the parallelograms are equal in area.

4. In a right-angled triangle prove that the square on the hypotenuse is equal to the sum of the squares on the other two sides.

If two unequal right-angled triangles ABC, ADC are drawn on opposite sides of their common hypotenuse AC, and if AM, CN are drawn perpendicular to BD, cutting it in M, N, prove that $BM^2+BN^2=DM^2+DN^2$.

5. If a straight line AB is bisected at C and produced to any point D, prove that $CD^2=AD.BD+AC^2$.

Show how to find the position of D by a geometrical construction so that the rectangle $AD.BD$ shall equal the square on AB.

6. Show, with proof, how to construct a square equal in area to a given triangle, illustrating your method by a well-drawn figure.

7. Prove that the angle at the center of a circle standing on a given arc is double any angle at the circumference standing on the same arc.

Prove that, if a square be described externally on the hypotenuse of a right-angled triangle, and the right angle be joined to the center of the square, the joining line will bisect the right angle.

8. The angles A, B of a cyclic quadrilateral $ABCD$ are 110°, 85°, respectively, and AB subtends an angle of 65° at the point of intersection of the diagonals. Find the angles which the sides subtend at the center of the circle.

9. Prove that in equal circles (or the same circle) equal angles at the centers stand on chords which are equal.

Given the base BC and the vertical angle A of a triangle ABC, the angle A being acute; prove that if BM is drawn perpendicular to AC, cutting it in M, and if CN is drawn perpendicular to AB, cutting it in N, the line MN is of constant length.

10. If two chords AB, CD of a circle, on being produced, meet in a point P, prove that the rectangles $PA.PB$ and $PC.PD$ are equal.

Two circles having a common chord AB cut a third circle, the chords of intersection with it being CD, EF, respectively. Prove that AB, CD, EF, produced if necessary, intersect in a common point.

MECHANICS.

Wednesday, January 12—Afternoon, 2.30 to 5.30.

1. The gravitational acceleration at the surface of the moon is approximately 5.4 feet per second. Calculate (*a*) the time taken by a projectile, starting vertically upward from the surface of the moon with a velocity of 120 feet per second, to return to its starting point, and (*b*) the maximum height reached.

How do these results compare with those upon the earth's surface?

2. Explain the variations of the force between the floor of a lift and the feet of a man standing in it during the upward and downward journeys from rest to rest.

3. Give exact definitions of the terms *force*, *momentum*, *work*, and *power*, and explain the connections between (*a*) force and momentum, (*b*) force and work, and (*c*) work and power.

4. Explain the principle by which the resultant of two forces not in the same straight line is determined.

The bob of a simple pendulum is deflected so that the string makes an angle of 30° with the vertical. It is then released. Calculate the direction and magnitude of the acceleration with which the bob begins to move.

5. Show how to calculate the magnitude and position of the resultant of a number of parallel forces acting in a plane.

Equal weights are situated at five of the angular points of a horizontally placed regular hexagon of side a. Find the line of action of the single force which would be in equilibrium with the weights.

6. Apply the principle of work to determine the mechanical advantage of a smooth plane inclined at an angle α to the horizontal, the load being raised by a horizontally applied force.

Show what would be the effect of friction on the mechanical advantage; and explain what is meant by the efficiency of a machine.

7. Define the *density* and the *relative density* of a substance.

Describe carefully how you would carry out—using a suitable bottle—a determination of the density of (*a*) a liquid, (*b*) a powder soluble in water, but insoluble in the liquid.

8. Explain how the pressure of the atmosphere can be accurately measured.

At the top of a mountain a mercury barometer reads 67.2 cm. What is the pressure in kilograms weight per sq. cm., given that mercury has 13.6 times the density of water.

APPENDIX B.

ENGLAND.

ENTRANCE SCHOLARSHIPS EXAMINATION PAPERS.

CAMBRIDGE UNIVERSITY.

EXAMINATION FOR SCHOLARSHIPS, EXHIBITIONS, AND SIZARSHIPS.

Trinity, Clare, Trinity Hall, Peterhouse, and Sidney Sussex.

December 7, 1910. 9–12.

1. The lines AB, BE, CF are drawn perpendicular to the sides BC, CA, AB of the triangle ABC, and EF, FD, DE are drawn to cut BC, CA, AB, respectively, in X, Y, Z. The tangents at A, B, C to the circle ABC cut BC, CA, AB, respectively, in P, Q, R, and L, M, N are the middle points of AP, BQ, CR, respectively. Prove that the six points X, Y, Z, L, M, N are on the radical axis of the circles ABC and DEF.

2. A, B are the points of contact of a common tangent of two given circles, and any line parallel to AB cuts one circle in P and the other in Q. Prove AP and BQ intersect on a fixed circle coaxial with the given circles.

3. Find three points X, Y, Z on the sides BC, CA, AB of the triangle ABC, such that YZ, ZX, XY will pass, respectively, through three given collinear points L, M, N.

Hence, or otherwise, find the points of contact of three given tangents to a conic having also given the pole of a given straight line.

4. Prove that, if n is a positive integer,

$$1-\frac{n}{1^2}x+\frac{n(n-1)}{1^2.2^2}x^2-\frac{n(n-1)(n-2)}{1^2.2^2.3^2}x^3+\cdots$$

$$=e^x\left\{1-\frac{(n+1)}{1^2}x+\frac{(n+1)(n+2)}{1^2.2^2}x^2-\frac{(n+1)(n+2)(n+3)}{1^2.2^2.3^2}x^3+\cdots\right\}.$$

5. Prove that, if a, β, γ are the three roots of the equation

$$x^3-21x+35=0;$$

then will

$$a^2+2a-14 \text{ be equal to } \beta \text{ or to } \gamma.$$

6. Prove that

$$\cos 2\alpha \sin(\beta-\gamma)+\cos 2\beta \sin(\gamma-\alpha)+\cos 2\gamma \sin(\alpha-\beta)$$
$$=4 \sin \tfrac{1}{2}(\beta-\gamma) \sin \tfrac{1}{2}(\gamma-\alpha) \sin \tfrac{1}{2}(\alpha-\beta)\,\{\cos(\beta+\gamma)+\cos(\gamma+\alpha)+\cos(\alpha+\beta)\}.$$

7. The diameter AB of a circle is produced to C so that BC is equal to the radius OB of the circle; CD is drawn perpendicular to OBC and $CD=BC$. A point P is taken on the circle on the same side of AB as the point D, and such that $\angle AOP$ is half a right angle. Prove that, if Q is the point where PD cuts the circle again, $\angle BOQ$ is 1.001 radians, very nearly.

8. Prove that chords of the ellipse $x^2/a^2+y^2/b^2-1=0$ which subtend a right angle at a given point P of the ellipse intersect the normal at P in a point P', such that PP' is equal to $2abd/(a^2+b^2)$, where d is the semidiameter conjugate to CP.

Prove that as P varies the locus of P' is a similar ellipse, and that the normals to the ellipses at P and P', respectively, intersect either ellipse in four concyclic points.

9. Show that the locus of the intersection of normals at the extremities of chords of a parabola which pass through a fixed point is a parabola, and find the direction its axis.

10. Find the equation of the tangent at the point $(p^2, 1, p)$ on the conic $\alpha\beta-\lambda^2=0$; and prove that, if the sides of a triangle touch the conic and two of its vertices are on the lines $\alpha-\lambda_1\beta=0$ and $\alpha-\lambda_2\beta=0$, respectively, the locus of the third vertex is the conic

$$(\lambda_1+\lambda_2)^2\alpha\beta-4\lambda_1\lambda_2\gamma^2=0.$$

11. Show that if θ and ϕ lie between 0 and π, a^2 is less than 1, and

$$(1-2a\cos\theta+a^2)\,(1+2a\cos\phi+a^2)=(1-a^2)^2,$$

then

$$\frac{d\theta}{d\phi}=\frac{\sin\theta}{\sin\phi}=\frac{1-2a\cos\theta+a^2}{1-a^2}.$$

12. Prove that if the chord of curvature through the origin is $2r^n/a^{n-1}$ $(n\neq 1)$, for any point of a curve at distance r from the origin, then the radius of curvature is proportional to

$$\frac{a^{n-1}}{r^{(n+1)}e^{(n-1)r^{(n-1)}}}.$$

December 7, 1910. 1-4.

BOOKWORK.

Candidates are requested to attempt at least ONE *question from each section of the paper, and not more than* THREE *in all.*]

1. Write a short account of the method of projection in geometry. Include in this account the properties of a projected figure corresponding to (*a*) circles, (*b*) right angles, (*c*) a pair of equal angles, (*d*) middle points of lines, and (*e*) foci of conics, in the original figure, and illustrate your theory by stating in a form true for all conics the property that the angle at the center of a circle is double that at the circumference.

2. Prove that if m is prime to a the least positive remainders of the series of integers

$$k,\ k+a,\ \ldots\ k+(m-1)a$$

with respect to m are a permutation of the numbers of the series

$$0,\ 1,\ 2,\ \ldots\ (m-1),$$

and that

$$a^{\phi(m)}-1\equiv 0\ (\text{mod. } m),$$

where $\phi\ (m)$ is the number of integers less than m and prime to it.

Prove, also, that $(m-1)!+1$ is divisible by m if, and only if, m is a prime.

Show that if m is a prime and $p<m$,

$$(p-1)!(m-p)!+(-1)^{p-1}\equiv 0(\text{mod. } m).$$

3. State and prove the leading propositions in the theory of determinants and indicate some applications of the theory.

4. Starting from the definition of a differential coefficient, develop methods and results which will enable you to differentiate any function obtained by combining exponential functions, circular functions, powers, and the inverses of these functions.

5. Establish formulæ for the curvature at any point of a plane curve, including the cases when the curve is defined (*a*) by a Cartesian equation, (*b*) by equations of the type $x=\phi(t)$, $y=\psi(t)$, (*c*) by an intrinsic equation, (*d*) by a p, r equation, and (*e*)

as the envelope of a line whose equation contains one variable parameter. Apply such of these formulæ as are suitable to the cases of the ellipse and the parabola.

6. Starting with any definition of exp x or log x, where x is a real variable, develop the principal properties of these functions, including among your results the expansions for exp x and log $(1+x)$, the equation.

$$\frac{d}{dx}(\log x)=\frac{1}{x},$$

and the relation

$$\lim_{n\to\infty}\left(1+\frac{x}{n}\right)^n=\exp x.$$

Explain, also, the connection between exp x and e^x.

A. Prove the theorems on which graphic methods as applied to statical problems depend.

B. Investigate the various theorems concerning the conservation of energy and the conservation of momentum under appropriate conditions for a system of two particles.

Apply your theorems to the solution of the following problem: Two particles of masses m and m' are connected by an elastic string, of natural length l and without mass, and are initially at rest at a distance $\frac{1}{2}l$ from each other at points A and B, respectively. Blows P and Q are applied to the particles in directions perpendicular to AB and toward A, respectively. Discuss the subsequent motion.

C. Investigate the various problems arising from the collision of smooth elastic spheres. In particular consider the loss of kinetic energy.

A mass m of water issues per unit time from a pipe with uniform velocity u and strikes a pail which retains it, there being no elasticity. Initially the pail is at rest, and at a subsequent instant is moving in the direction of the stream with velocity V. Prove that

$$\frac{dV}{dt}=\frac{m(u-V)^3}{Mu^2},$$

and that the loss of energy up to this instant is

$$\tfrac{1}{2}MuV,$$

where M is the mass of the pail, and gravity is omitted from consideration.

D. Investigate the theory of the isochronism of oscillations, considering harmonic motion in general, motion on a cycloid, and the small oscillations of a pendulum.

December 8, 1910. 9–12.

FOR CANDIDATES IN MATHEMATICS, IN MECHANICAL SCIENCES, AND IN MATHEMATICS APPLICABLE TO PHYSICS.

Mathematical tables and squared paper are provided, and mathematical instruments may be employed for calculation.

Candidates for mathematical scholarships are to omit questions A–C.

A. Prove the formula

$$\cos(A+B)=\cos A\cos B-\sin A\sin B.$$

Show that

$$\sin A\sin(B-C)+\sin B\sin(C-A)+\sin C\sin(A-B)=0.$$

B. Find the length of the perpendicular from the origin to the line

$$3x+4y-1=0.$$

Find also the equations of the two lines which are parallel to this line and at twice its distance from the origin.

C. Trace the curve y^2-16x, and find the points where it is cut by the line $y=2x-6$. Prove also that the line cuts the curve at angles ϕ and ϕ' given by

$$\tan\phi=\tfrac{4}{7},\quad \tan\phi'=\tfrac{4}{3}.$$

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1. The bisector of the angle A of a triangle ABC passes through the center of the square described externally on BC. Show that A is a right angle, or that $AB=AC$.

2. $ABCD$ is a quadrilateral not inscribable in a circle. Show that

$$AC.BD<AB.CD+BC.AD.$$

3. The roots of the equation

$$x^4-12x^3+51x^2-92x+60=0$$

are all integral; find them.

4. Prove that if x is the nth root of a, the error involved in taking x for the $(n+q)$th root of a is

$$\frac{qx\log_e x}{n+q}\left\{1-\frac{q\log_e x}{2\,(n+q)}\right\}\text{approximately,}$$

where

$$\frac{q\log_e x}{n+q}$$

is small.

Estimate roughly the extreme magnitude of this error when x and q are not greater than 1,000 and 1, respectively, and n is not less than 200.

5. Solve (graphically or otherwise) to two significant figures the equation

$$x^3-10x-11=0.$$

6. Find the general solution of the equation

$$\text{cosec } 4a-\text{cosec } 4\theta=\cot 4a-\cot 4\theta.$$

7. Solve completely the triangles in which

$$a=113,\quad b=152,\quad A=27°.$$

8. In an acute-angled triangle ABC, if LMN is the pedal triangle and ρ its in-radius, show that

$$LM\,.\,MN\,.\,NL=2\rho\Delta,$$

where Δ is the area of ABC.

9. Interpret the equations obtained by eliminating x and y in succession between the straight line $x+2y=3$ and the conic $x^2-3y^2=22$, and hence (or otherwise) prove that the circle described on this chord as diameter has for its equation

$$x^2+y^2+18x-12y-128=0.$$

10. Find the relation between the eccentric angles at the extremities of conjugate diameters of an ellipse.

If the ellipse be

$$x^2/a^2+y^2/b^2=1,$$

prove that the tangents at the ends of conjugate diameters intersect on the ellipse

$$x^2/a^2+y^2/b^2=2,$$

and that the corresponding normals meet on the curve

$$2\,(a^2x^2+b^2y^2)^3=(a^2-b^2)^2\,(a^2x^2-b^2y^2)^2.$$

11. Prove the rule for differentiating the quotient of two functions.

Find the differential coefficients of

$$\frac{x-2}{\sqrt{2x^2-2x+5}},\quad \sin\left\{\frac{1+x^2}{1+x^3}\right\},\quad \tan\,(x-\sin^{-1}x).$$

12. A bell tent consists of a conical portion above and a cylindrical portion near the ground. For a given volume and a circular base of given radius, prove that the amount of canvas used is a minimum when the semivertical angle of the cone is $\cos^{-1}(\frac{2}{3})$.

13. Integrate the following expressions:

$$\frac{x}{(x^2+3x+2)},\quad \tan^2 x,\quad x^2 \log x,\quad \frac{1}{\sqrt{2-x}+\sqrt{1+x}}.$$

14. Apply the integral calculus to evaluate
    (i) the area of a parabola cut off by a line perpendicular to the axis;
    (ii) the volume of a sphere.

15. Trace the curve $xy^2=4a^2(2a-x)$ and prove
    (i) that the area between the curve and the axis of y is $4\pi a^2$;
    (ii) that the volume generated by the revolution of the curve about this line is $2\pi^2 a^3$.

December 8, 1910. 1.30–4.30.

FOR CANDIDATES IN MATHEMATICS, IN MECHANICAL SCIENCES, AND IN MATHEMATICS APPLICABLE TO PHYSICS.

Mathematical tables and squared paper are provided, and mathematical instruments may be employed for calculation.

1. A ship leaves a certain port and steams N.W. at 15 knots; 10 hours later another ship leaves the same port, and steams W. S. W. at 12 knots. Their wireless instruments are capable of communications up to 500 nautical miles; how long may the ships expect to remain in touch with one another?

[A knot=a nautical mile an hour.]

2. A train passes a station A at 40 miles per hour and maintains this speed for 7 miles, and is then uniformly retarded, stopping at B, which is 8 miles from A. A second train starts from A the instant the first train passes and, being uniformly accelerated for part of the journey and uniformly retarded for the rest, stops at B at the same time as the first train. What is its greatest speed on the journey?

3. A tramcar starts from rest and its velocities at intervals of 5 seconds, are given in the following table:

Time	0	5	10	15	20	25	30
Velocity in miles per hour	0	8.1	11.8	14.6	16.3	17.7	19

Calculate the distance in yards traveled in the above time. Also, if the car weighs 8 tons, estimate the effective pull exerted on the car at the end of 20 seconds.

4. A particle is projected from a given point with a velocity whose vertical component is given. Prove that the initial angular velocity about the focus of the path is greatest when the angle of projection is 45°.

5. A smooth sphere is tied to a fixed point by an inelastic string, and another sphere impinges directly on it in a direction making an acute angle with the string. Show that, if the second sphere is reduced to rest by the impact, the ratio of the total kinetic energy after the impact to that before is equal to the coefficient of restitution.

6. A light spring is such that m lbs. weight compresses it a feet. It is compressed c feet ($c > a$). If m' lbs. is placed on the top and the spring is released, find the condition that the weight will leave the spring, and its velocity when this happens.

7. Four equal masses are attached at equal distances A, B, C, D at points on a light string, and so placed that $\angle ABC = \angle BCD = 120°$, and the various parts of the string are straight; an impulse I is given to the mass at A in the direction BA, show that the impulsive tension in AB is $\frac{15}{28}$ I.

8. A heavy uniform beam, 8 feet long, weighs 20 lbs., and at one end it carries a load of 20 lbs. and at the other end a load of 10 lbs. The beam thus loaded is to be carried on a certain support. Find by a graphical construction the position of the support.

If the beam is to rest on two supports which are to divide the load in a given ratio, show how to find on your diagram any number of suitable pairs of points, and find the position of the supports when they are at a distance 4 feet apart, the pressures on them being in the ratio of 3 to 2.

9. A tripod consists of three equal rods, each of weight w, smoothly jointed at the upper ends. It is placed symmetrically on a rough horizontal table, for which the angle of friction is ϕ, and a weight W is put on the top of the tripod. Show that the rods can not make an angle with the vertical greater than

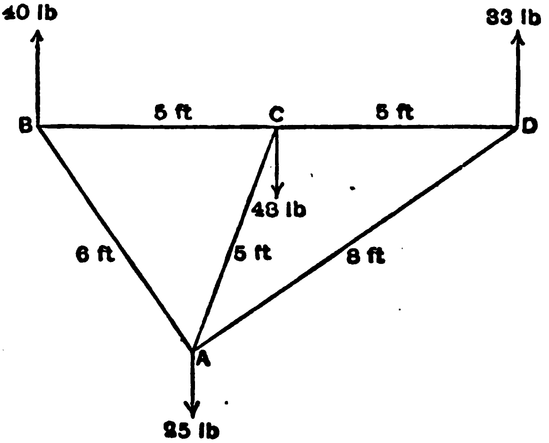
$$\tan^{-1}\left(2\frac{W+3w}{2W+3w}\tan\phi\right).$$

10. Two equal uniform rods are fastened together so as to bisect one another at right angles. They rest in a plane at right angles to a rough wall, the one rod resting on the edge of the top of the wall, and an end of the other against the vertical side. Prove that the limiting inclination θ of the second rod to the vertical is given by the equation

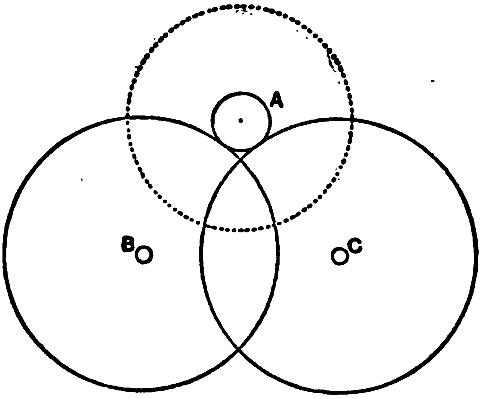
$$\tan\theta\cos^2\lambda = \cos(\lambda+\theta)\sin(\lambda-\theta),$$

where λ is the angle of friction.

11. The figure $ABCD$ represents a freely-jointed light plane framework, with forces acting in the plane at right angles to BCD. Show that it is in equilibrium, and prove, graphically or otherwise, that the stresses in AB, AC are equal and of opposite sign.



12. Two equal friction-wheels of radii R inches turn on axles B, C of radii r inches; the coefficient of friction between wheel and axle is $\tan\phi$. A wheel of weight W is attached to an axle of radius a inches which rests on the circumferences of the first two wheels as in the figure. Neglecting the weights of the wheels B and C, show that the least couple which will rotate the wheel A is $Wa\frac{\sin 2\theta}{\sqrt{3}}$, where $\sin\theta = \frac{r}{R}\sin\phi$: the centers



of the three wheels forming an equilateral triangle.

(ALTERNATIVE QUESTIONS IN PHYSICS.)

13. A diving bell has the form of a paraboloid of revolution cut off by a plane perpendicular to its axis at a distance h from the vertex, where h is the height of the water barometer. If the bell be lowered so that its vertex is at a depth $5h/2$ below the surface of the water, find how high the water will rise in the bell.

14. A battery is connected to a galvanometer of 40 ohms resistance, and a certain current is observed. The galvanometer is now shunted with a resistance of 10 ohms, and the current in the galvanometer falls to one-half of the former value. Find the internal resistance of the battery.

15. The coefficients of cubical expansion of mercury and brass are .00018 and .00006 per degree centigrade. A mercury barometer with a brass scale reads correctly at 15° C., standing at 30 inches; what will be the error at 35° C.?

16. One cubic foot of air at a temperature of 500° C. absolute is expanded isothermally from a pressure of 120 lbs. per sq. in. to twice the initial volume; it is then expanded adiabatically to three times the initial volume. Find the pressure and temperature at the end of each stage and calculate, graphically or otherwise, the work done and the heat units taken in during each stage, taking the mechanical equivalent of one thermal unit as 1,400 ft. lbs., and the equation for adiabatic expansion of air as $pv^{1\cdot 4}=\text{const.}$

APPENDIX C.

FRANCE.

CONCOURS FOR ADMISSION TO THE ÉCOLE NORMALE SUPÉRIEURE AND FOR THE BOURSES DE LICENCE IN 1913.

MATHEMATICS.[1]

GROUP I.

I.

(Time: 6 hours.)

Being given three axes of rectangular coordinates Ox, Oy, Oz, consider the surface (S) defined by the equation $z=xy+x^3$ and the line (D) defined by the equations $y=b$, $z=c$, where b and c are two given constants, the second not being zero. In all that follows this line (D) remains fixed.

1. Show that the surface (S) is ruled and find its generators.

2. To each rectilinear generator (G) of the surface (S) establish a correspondence of the plane (P) drawn through the line (D) and parallel to the line symmetric to (G) with respect to the plane xOy. Determine the locus of the point of intersection of (G) and of (P), when the line (G) describes the surface (S).

Show that this locus is a curve (C) situated on a quadric (Q), and determine this quadric.

3. Form the equation of the fourth degree, giving the abscissas of the points of intersection of the curve (C) with a plane given by its equation $ux+vy+wz+s=O$. Calculate the elementary symmetric functions of the roots as a function of u, v, w, s. From this deduce the relation which the abscissas x_1, x_2, x_3, x_4, of four points of the curve (C) must satisfy in order that these four points should be in the same plane.

This relation will be useful in most of the questions which follow.

4. Deduce from the preceding relation the conditions which the abscissas x_1, x_2, x_3, of three points of the curve (C) must satisfy in order that these three points shall be collinear.

Form the general equation of the third degree of which the roots are the abscissas of three collinear points of the curve (C). Show that the lines which cut (C) in three points generate one of the families of rectilinear generators of the quadric (Q).

5. Show that the necessary and sufficient condition that the osculating planes to the curve (C) in three given points cut on the curve (C) is that the three points are collinear.

6. Through any point M of the curve (C) there pass two planes enjoying the property of being tangent to the curve (C) at the point M and in another point (that is to say of being bitangent to the curve). Suppose M' and M'' are the second points of contact of these two planes. Show that there exists a plane bitangent to the curve (C) in M' and M''.

What conditions must be satisfied by the abscissas of the three points M, M', M'', of the curve (C) in order that any two of them are points of contact of a plane bitangent to the curve (C)?

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[1] The solutions of the following problems are to be found in *Nouvelles Annales de Mathématiques*, tome 73, Oct.-Nov., 1914, pp. 467–482.

7. Form the general equation of the third degree whose roots are the abscissas of the points M, M', M'', of the curve (C) subject to the preceding conditions. Express the coefficients of this equation by means of the abscissa ϵ of the fourth point of intersection μ of the curve (C) with the plane (π) determined by the points M, M', M''.

Calculate, in terms of ϵ the coefficients of the equation of the plane (π) and the coordinates of the point of concourse, A, of the tangents to the curve (C) at the points M, M', M''. This point A is said to be the point associated with the point μ of the curve (C).

8. Show that there exists an infinity of quadrics, depending only on b and c, with respect to which the point A is the pole of the plane (π); determine these quadrics and show that one of them is the quadric (Q) already considered.

Determine the locus (Γ) of the point A, also the envelope of the plane (π), when the point μ describes the curve (C).

9. With any three collinear points μ_1, μ_2, μ_3, on the curve (C) are associated the three vertices A_1, A_2, A_3, of a triangle inscribed in the curve (Γ). Determine by supposing $b=0$, the envelope of the sides of this triangle when the line $\mu_1\,\mu_2\,\mu_3$ varies. Show that in the same hypothesis $b=0$, the circle circumscribed about the triangle $A_1\,A_2\,A_3$ passes through two fixed points.

II.

(Time: 4 hours.)

Given two rectangular axes, and the differential equation $y-2xy'+y^2y'^3=0$.

1. Show that this equation admits of an infinity of solutions, the curves C, of which the equation is of the form $y^2=f(x)$, $f(x)$ denoting a polynomial in x. Write the general equation of the curves C; show that through every point of the plane there passes either one or three curves C, and determine the region of the plane where the point ought to be found in order that the number of the curves which pass through it shall equal three; determine the locus of the points such that two of the curves C which pass through one of them are orthogonal.

2. Given the point A $(x=0.5, y=0)$. Let P be that one of the curves C which passes through A and is concave toward the positive part of the axis Ox; let B be the point of the curve P which has for ordinate $\sqrt{6}$. Suppose Q is that one of the curves C passing through B and concave toward the negative part of the x-axis; suppose finally that A' is the point where this curve cuts the axis Ox. Calculate the area bounded by the arcs of curves AB, BA', and the axis Ox.

3. A moving point, starting from A, traverses successively the arc AB of P, then the arc BA' of Q. Its tangential acceleration is constantly equal to its velocity, and its initial velocity is equal to 1; at the point B suppose that the velocity does not change in magnitude, but only in direction. Calculate to the nearest tenth the time taken for the point to traverse the arc ABA'.

4. At the point B, the acceleration of the moving point suffers a discontinuity. Calculate, by its projections on the two axes of coordinates, the geometric variation of the vector-acceleration at the point B.

Group II.

I.

Consider in a plane two rectangular coordinate axes Ox, Oy. A material point M, of mass equal to unity, is movable in a plane under the action of a force (F) of which the projections X and Y on the axes are $X=x$, $Y=y-4x$, x and y denoting the coordinates of the point M:

1. Form and integrate the differential equations of the motion of the point M.

2. Determine the motion of M in supposing that at the beginning of the time its coordinates are $(\alpha, 0)$ and that its velocity has $-\alpha$ and 2α for projections on the axes. Construct the trajectory (T) corresponding to this motion.

3. Calculate the time taken by the moving point in going from any point M of its trajectory (T) to the point M', where the tangent to the trajectory is parallel to the radius vector OM.

4. Prove that the hodograph of the motion is a homothetic curve of the trajectory (T) and calculate to the nearest tenth the ratio of homothety.

5. The trajectory (T) passes through the point O. Evaluate, in terms of the abscissa of the point M, the area bounded by the arc of the curve OM and the chord OM, also the volume generated by this area turning about Oy.

II.

Evaluate to the nearest hundredth the integrals:

$$\int_0^\pi \frac{dx}{2\cos x+3}, \qquad \int_0^\pi \frac{dx}{(2\cos x+3)^2}.$$

Note.—*For interesting comment concerning the emphasis on analytical geometry in the above examination, compare E. Blutel's report, page 21 (Commission Internationale de l'Enseignement Mathématique. Sous-Commission Française, Rapports, vol. 2).*

APPENDIX D.

FRANCE.

Agrégation des Sciences Mathématiques.

As there are no mathematical examinations for teachers in any other country to compare in difficulty with those to which the candidate for a French agrégation is required to submit, it seems worth while to give fuller details. I therefore subjoin:

I. Concours programs (announced 9–11 months in advance). The examinations were on topics selected from the program.

II. The corresponding examination papers. The four written examinations occurred within five consecutive days. The first paper may seem short for the time allowed (seven hours), but when the enormously high standard in presentation and detail is taken into consideration, this is not found to be the case.

I. PROGRAM FOR THE CONCOURS.

I.—General Program in Analysis and Mechanics, 1914.[1]

Since the programs for the certificats d'études supérieures vary among the different universities, the jury indicate in the program below the minimum of general knowledge which the candidates for certificats in analysis (differential and integral calculus) and mechanics are supposed to have acquired.

The subjects of the "compositions" in differential calculus, integral calculus, and mechanics will be chosen from Nos. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, and 15 of this program; their scope will not exceed the standard set by the subjects of problems proposed for the corresponding certificats for the licence.

Differential Calculus and Integral Calculus.

1. *Fundamental operations of differential and integral calculus:* Derivatives and differentials; simple integrals, curvilinear integrals, integrals of total differentials, double and triple integrals.

2. *Applications of the differential calculus:* Study of functions of a real variable (Taylor's formula, maxima and minima, functional determinants, implicit functions); calculation of derivatives and differentials; change of variables. Order of connection and class of an area.

3. *Applications of the integral calculus:* Processes of integration. Length of an arc of a curve (plane and gauche), areas, volumes. Differentiation and change of variables under the sign $\int\int$ . . . Study of the integral $\int_a^b f(x)\,dx$ when one of the limits or the function becomes infinite. Green's formula. Study of functions represented by certain series. Properties of power series.

4. *Elements of infinitesimal geometry:* "Infinitesimal properties" of plane and gauche curves (curve envelopes, curvature, torsion). Infinitesimal properties of surfaces; surface envelopes, summary of the results on contact transformations; developable surfaces, ruled surfaces; Meusnier's theorem; principal sections. Conjugate lines, lines of curvature, asymptotic lines in any curvilinear coordinates.

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[1] *Bulletin administratif du ministère de l'instruction publique*, année 1913, 26 Juillet, pp. 172–174. Although the program for 1915 was published, no examination has been held since 1914.

5. *Elementary functions of a complex variable:* Simple algebraic functions; circular and logarithmic functions.

6. *Theory of analytic functions:* Properties of the integral $\int f(z)\,dz$. Series of Taylor and of Laurent. Poles, essentially singular points, residues. Reduction of the hyperelliptic integrals.

7. *Differential equations of the first order:* General solutions, particular solutions, singular solutions. Simple types of integrable equations. Integrating factor. Theorem of Briot and Bouquet on the existence of the solutions in the cases where the known functions are analytic.

8. *Differential equations and systems of equations of any order:* General solution, particular solutions, first solutions. Simple types of integrable equations. Linear equations.

9. *Integration of linear partial differential equations of the first order.*

10. *Integration of differential equations (partial or total) of the first order.*

MECHANICS.

11. *Statics:* Composition of forces applied at a point. Attraction of a spherical homogeneous shell at an exterior or interior point. Elementary properties of potential. Reduction of forces applied to a solid body. Conditions of equilibrium of a solid body. Applications to simple machines. Funicular polygon. Suspension bridges. Catenary. Principal of virtual work.

12. *Kinematics:* Velocity, acceleration. Movement of a plane figure in its plane. Representation of the movement by the rolling of a moving curve on a fixed curve. Movement of a solid body about a fixed point. Representation of the movement by the rolling of a moving cone on a fixed cone. Movement of a solid body in space. Helicoidal movement. Relative movements. Theorem of Coriolis.

13. *Dynamics of a particle:* Work. General theorems. First integrals of the equations of motion. Application to the motion of the planets. Movement of a point on a curve or on a surface. Pendulum in a vacuum and in a resisting medium. Conical pendulum. Geodetic lines.

14. *Geometry of masses:* Centers of gravity. Moments of inertia.

15. *Dynamics of systems:* General theorems. First integrals. Energy, stability of equilibrium. Movement of a solid body about a fixed axis. Pressure supported by the axis. Compound pendulum. Movement of a solid body about a fixed point. General movement of a solid body. Law of friction and slipping. Application of the principle of *vis viva* to machines. D'Alembert's principle. Lagrange's equations. Relative motion. Percussions.

16. *Canonical equations:* Jacobi's theorem.

17. *Hydrostatics:* Equilibrium of a fluid mass. Level surfaces. Pressure on a plane wall. Archimedes's principle. Equilibrium of floating bodies.

18. *Hydrodynamics:* General equations of motion of a fluid mass. Bernoulli's theorem. Torricelli's theorem.

LESSONS.[1]

Parts of the programs from which are drawn the subjects of the lessons.

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[1] Although the program of "Lessons" for 1914 is given on pp. 175–177 of the *Bulletin Administratif* mentioned above, the examinations on these lessons took place after the war had commenced, and I have been unable to find any published list of lesson-subjects selected at that time. As the program of lessons for 1910 and the corresponding list of lesson-subjects were available, they are given in this appendix. There is considerable variation in the program of "Lessons" from year to year.

Mathématiques Spéciales.

Series: Series of positive terms; character of convergence or divergence drawn from the study of the expressions: $\frac{u_{n-1}}{u_n}$, $\sqrt[n]{u_n}$, nu_n.
Absolutely converging series. Convergence of series, with terms alternately positive and negative, of which the general term decreases constantly in absolute value and tends toward zero. Numerical examples.

General properties of algebraic equations: Number of roots of an equation. Relations between the coefficients and the roots. Every rational and symmetric function of the roots may be expressed rationally as a function of the coefficients. Elimination of one unknown between two equations by means of symmetric functions. Condition that an equation has equal roots. Study of the commensurable roots. Descartes's theorem. Complex numbers. De Moivre's theorem. Trigonometric resolution of the binomial equation.

Functions: Function of a real variable, graphic representation, continuity. Definition and continuity of the exponential function and of the logarithmic function. Limit of $\left(1+\frac{1}{m}\right)^m$ when m increases indefinitely in absolute value. Derivative of a function; slope of the curve represented. Derivative of a sum, of a product, of a quotient, of an integral power, of a function of a function. Derivative of a^x and of $\log x$. Use of logarithm tables and of the slide rule. Rolle's theorem, law of finite increments, graphic representation. Functions of several independent variables, partial derivatives. Law of finite increments. Derivative of a compound function. Derivative of an implicit function (admitting the existence of this derivative). Employment of the derivative for the study of the variation of a function; maxima and minima. Primitive functions of a given function, their representation by the area of a curve.

Functions defined by a power series with real coefficients. Interval of convergence: Addition and multiplication. In the interior of the interval of convergence one obtains the derivative or the primitive functions of the function, on taking the series of derivatives or of the primitive functions (functions which extend to the extremities of the interval are not considered). Examples: Developments in series of $\frac{1}{1-x}$, $\frac{1}{1+x^2}$, $\arctan x$, $\log(1-x)$, $\log\frac{1-x}{1+x}$. Exponential series. Binomial series. The equations $y'=y$, and $y'(1+x)=my$ serve to determine the sum of the last two series. Development into series of a^x, of arcs in x.

Curves whose equation is resolved or resolvable with regard to one of the coordinates: Tracing. Equation of the tangent at a point; subtangent. Normal, subnormal. Concavity, convexity, points of inflexion. Asymptotes. Application to simple examples and in particular to the conics and to those curves of which the equation is of the second degree with respect to one of its coordinates.

Curves defined by the expression of the coordinates of one of their points as functions of a parameter: Tracing. Numerical examples. Curves of the second order and those of the third order with a double point are unicursal.

Curves defined by an implicit equation: Equation of the tangent and of the normal at a point. Tangents at the origin in the case where the origin is a simple point or a double point. Discussion of the asymptotes in the case of numerical examples of curves of the second and of the third order.

Curvature. Envelopes. Developables.

Polar coordinates: Their transformation into rectangular coordinates. Equation of a right line. Construction of curves; tangents, asymptotes. Applications (confined to the case when the equation is solved with respect to a radius vector). Case of the conics.

Gauche curves: Tangent. Osculating plane. Curvature. Applications to the circular helix.

Study of surfaces of the second degree with reduced equation: Condition of the contact of a plane with a surface. Simple problems relative to tangent planes. Normals. Properties of conjugate diameters. Theorems of Apollonius for the ellipsoid and the hyperboloids. Circular sections. Rectilinear generatrices. The surfaces of the second order are unicursal.

DYNAMICS.

1. *Free material point:* Principle of inertia. Definition of force and mass.[1] Relation between the mass and the weight. Invariability of the mass. Fundamental units. Derived units. Movement of a point under the action of a force, constant in magnitude and direction, or under the action of a force issuing from a fixed center: (1) Proportional to the distance; (2) in the ratio inversely as the square of the distance. Composition of forces applied at a material point.[2] Work of a force, work of the resultant of several forces, work of a force for a resulting displacement. Theory of living force. Level surfaces. Fields and lines of force. Kinetic energy and potential energy of a particle placed in a field of force.

2. *Material point, not free:* Movement of a heavy particle on an inclined plane, with and without friction, the initial velocity acting along the line of greatest inclination. Total pressure on the plane; reaction of the plane. Small oscillations of a simple pendulum without friction; isochronism.

DESCRIPTIVE GEOMETRY.

Intersection of surfaces: Two cones or cylinders, cone or cylinder and surface of revolution, two surfaces of revolution of which the axes are in the same plane.

II.—LESSONS ON THE SUBJECTS OF THE PROGRAMME OF THE SECONDE AND PREMIÈRE (C AND D) AND MATHÉMATIQUES A.

Seconde (C and D).

Algebra: Resolution of equations of the first degree in one unknown. Inequalities of the first degree. Resolution and discussion of two equations of the first degree in two unknowns. Problems; substitution in equation. Discussion of the results. Variation of the expression $ax+b$; graphic representation. Equations of the second degree in one unknown (theory of imaginaries not discussed). Relations between the coefficients and the roots. Existence and signs of the roots. Study of the trinomial of the second degree. Inequalities of the second degree. Problems of the second degree. Variation of the trinomial of the second degree. Graphic representation. Variation of the expression $\frac{ax+b}{a^1x+b^1}$; graphic representation. Notion of derivative; geometrical significance of the derivative. The sign of the derivative indicates the direction of the variation; applications to very simple numerical examples and in particular to the functions studied before.

Geometry: Simple notions of homothetic figures. Similar polygons. Sine, cosine, tangent, and cotangent of positive angles less than two right angles. Metrical relations in a right triangle and in any triangle. Proportional lines in the circle. Fourth proportional; mean proportional. Regular polygons. Inscription in a circle of a

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[1] It is admitted that a force applied at a material point is geometrically equal to the product of the mass of the point by the acceleration that it impresses on the point

[2] It is admitted that, if several forces act at a point, the acceleration that they impress on the point is the geometric sum of the accelerations that each of them impresses on it, if acting alone.

square, of a hexagon; of an equilateral triangle, of a decagon, of a quindecagon. Two regular polygons of the same number of sides are similar. Ratio of their perimeters. Length of an arc of a circle. Ratio of the circumference to the diameter. Calculation of π (confined to the method of the perimeters). Area of polygons; area of a circle. Measure of the area of a rectangle, of a parallelogram, of a triangle, of a trapezium, of any polygon. Ratio of the areas of two similar polygons. Area of a regular convex polygon. Area of a circle, of a sector, and of a segment of a circle. Ratio of the areas of two circles.

Première (*C and D*).

GEOMETRY.

Translation: Rotation about an axis. Symmetry with respect to a line. Symmetry with respect to a point. Symmetry with respect to a plane. This second kind of symmetry is equivalent to the first.

Trihedral angles: Disposition of the elements. Trihedral symmetry. Each face angle of a trihedral is less than the sum of the other two. Limits of the sum of the face angles of a trihedral. Supplementary trihedrals. Applications. Inequalities of the trihedrals.

Homology: Parallel plane sections of polyhedral angles. Area.

Polyhedra: Homothetic polyhedra, similar polyhedra. Prisms, pyramids. Summary of notions on the symmetry of the cube and of the regular octahedron. Volumes of parallelepipeds and of prisms. Volume of a pyramid. Volume of a pyramid truncated by parallel sections. Volume of a truncated triangular prism. Ratio of the volumes of two similar polyhedra. Two symmetrical polyhedra are equivalent. Sphere: Plane section, poles, tangent plane. Circumscribed cone and cylinder. Area and volume.

Mathématiques A.

Arithmetic: Common fractions. Reduction of a fraction to its simplest terms. Reduction of several fractions to a common denominator. Least common denominator. Operations with common fractions. Decimal numbers. Operations (considering the decimal fractions as particular cases of ordinary fractions). Calculation of a quotient to a given decimal approximation. Reduction of an ordinary fraction to a decimal fraction; condition of possibility. When the reduction is impossible, the ordinary fraction can be regarded as the limit of an unlimited periodic decimal fraction. Square of a whole number or of a fractional number; nature of the square of the sum of two numbers. The square of a fraction is never equal to a whole number. Definition and extraction of the square root of a whole number or of a fraction to a given decimal approximation. Definition of absolute error and of relative error. Determination of the upper limit of an error made in a sum, a difference, a product, a quotient, knowing the upper limits of the errors by which the given quantities are affected. Metric system.

Algebra: Monomials, polynomials; addition, subtraction, multiplication, and division of monomials and of polynomials. Equations of the second degree in one unknown. Simple equations which are equivalent. (The theory of imaginaries is not developed.) Problems of the first and second degree. Arithmetic progressions. Geometric progressions. Common logarithms. Compound interest, annuities.

Trigonometry: Circular functions. Addition and subtraction of arcs. Multiplication and division by 2. Resolution of triangles. Applications of trigonometry to various questions relative to the elevation of planes. (The construction of the trigonometric tables is not to be considered.)

Geometry: Inversion. Applications. Peaucellier's cell. Polar of a point with respect to a circle. Polar plane of a point with respect to a sphere. Hyperbola:

Trace, tangent, asymptotes; simple problems on tangents. Equation of a hyperbola with respect to its axes. Plane sections of a cone and of a cylinder of revolution.

Vectors: Projection of a vector on an axis; linear moment with respect to a point; moment with respect to an axis. Geometric sum of a system of vectors; resultant moment with respect to a point. Sum of the moments with prospect to an axis. Application to a couple of vectors.

Descriptive geometry: Rabatting. Change of plane of projection; rotation about an axis perpendicular to a plane of projection. Application to distances and angles; distance between two points, between a point and a line, between a point and a plane; the shortest distance between two lines of which one is vertical or at right angles to the plane, or of two lines parallel to the same plane of projection; common perpendicular to these lines. Angle between two lines; angle between a line and a plane; angle between two planes.

Kinematics: Units of length and of time. Motion. Relative motion. Trajectory of a point. Examples of motion. Rectilinear motion; uniform motion; velocity, its representation by a vector. Varied motion, mean velocity; velocity at a given instant, its representation by a vector; mean acceleration; acceleration at a given instant; its representation by a vector. Uniformly varied motion. Curvilinear motion. Mean velocity, velocity at a given instant defined as vectors. Algebraic value of velocity. Hodograph. Acceleration. Uniform circular motion, angular velocity; projection on a diameter. Simple oscillation in a line. Change of the system of comparison. Resultant of velocities. Examples and applications. (Purely geometrical applications are not to be insisted upon.) Geometrical study of the helix. Helicoidal motion of a body. Screw and nut.

Dynamics: Work of a force applied to a material point. Unit of work. Work of a constant force, of a variable force. Elementary work, total work. Graphical evaluation. Work of the resultant of several forces. Theorem of forces acting on a material point. Simple examples.

Cosmography: Moon. Apparent proper motion on the celestial sphere. Phases. Rotation. Variation of the apparent diameter. Eclipses of the moon and of the sun.

II. EXAMINATIONS IN THE CONCOURS.

(1) *Written*, 1914.

MATHÉMATIQUES ÉLÉMENTAIRES.

(June 30. Time, 7 hours: 7 a. m. to 2 p. m.)

Let A_1, A_2, A_3, A_4, be the four vertices of a tetrahedron T. Let $a_{i.j}$ represent the length of an edge A_iA_j and $O_{i.j}$ the middle point of this edge. Denote also by (A, B) the sphere described on any segment AB as diameter.

1. Calculate one of the geometric products [1] of two opposite edges of T as a function of the edges of the tetrahedron. Find the relation which exists between three of these products with respect to the three pairs of opposite edges.

2. Find the relation which must subsist between the lengths of the edges of T in order that the two lines $O_{1.2}O_{3.4}$ and $O_{1.3}O_{2.4}$ should be at right angles.

3. Suppose d is the distance between the radical planes of each of the spheres (A_1, A_2), (A_3, A_4) and of the sphere $(O_{1.2}, O_{3.4})$. Let d' and d'' be the analogous corresponding distances in connection with the two other pairs of opposite edges of the tetrahedron. It is required to find the relations which must subsist between the edges of the tetrahedron in order that $d=d'=d''$.

Three vertices of such a tetrahedron being given, find the geometric locus of the fourth vertex. Discuss.

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[1] It is recalled that the geometric product of two vectors $\overline{AB}$, $\overline{CD}$ is the product of the lengths of these vectors and of the cosine of the angle between them.

4. Being given any point M, draw the two bisectors of the angle A_iMA_j. Let $w_{i.j}$ be the middle of the segment cut by these bisectors on the line A_iA_j; there are six points $w_{i.j}$. Demonstrate that these six points are in the same plane π which may be associated with the point M. Conversely, any plane π being given, one may establish a correspondence of this kind with two points M and M' which are themselves associated. What position must be given to the plane π in order that the corresponding points M and M' fall together? How must the plane π be displaced when a corresponding point M describes a circle the plane of which passes through the center of the sphere circumscribed about the tetrahedron?

5. Given a tetrahedron T, construct a point M_0 coincident with its associate and situated at the same distance from the three vertices A_1, A_2, A_3.

Find the surface S, locus of the vertex A_4 when T is deformed, A_1, A_2, A_3 remaining fixed and the ratio $\frac{M_0A_4}{M_0A_1}$ preserving a constant value k.

Let D be any line passing through A_1. Construct the points of intersection of D and of S, and find the locus of the lines D tangent to S and the locus of the point of contact.[1]

MATHÉMATIQUES SPÉCIALES.

(July 1. Time, 7 hours: 7 a. m. to 2 p. m.)

Given a hyperboloid of one sheet whose equation, with respect to its axes, is $\frac{x^2}{\lambda^2}+\frac{y^2}{\mu^2}-\frac{z^2}{\rho^2}-1=0$.

I. There exist two families of such hyperboloids susceptible of being generated by the intersection of planes at right angles to one another passing respectively through two fixed lines; we may pass from a hyperboloid H of the first family to a hyperboloid H' of the second family by rotation through a right angle about Oz.

Let D, Δ be the fixed lines with respect to H; D', Δ' the fixed lines with respect to H'; find the surface loci of D, Δ and of D', Δ', when λ, μ, vary, ρ remaining fixed.

There exist planes P parallel to the plane xOy cutting these surfaces in two curves which have a common point A situated on Oz, and a common real point B situated in the trihedral $Oxyz$; evaluate the area bounded by the arcs AB of the two curves, also the volume generated by this area when the plane P has one coordinate (*cote*) varying from z_1 to z_2.

II. With a hyperboloid H_1 of the first family, a correspondence may be established with an infinite number of hyperboloids of the second family such that the fixed lines with respect to H_1 and the fixed lines with respect to one of these latter form a gauche quadrilateral; let H_2 be such a hyperboloid; D_1, Δ_1, and D_2, Δ_2 the fixed lines with reference to H_1 and H_2 respectively; $ABCD$ the quadrilateral formed by these lines; show that the hyperboloid H_3 generated by the intersection of two planes cutting at right angles and passing respectively through the diagonals of the quadrilateral $ABCD$ appertains to the linear point pencil defined by H_1 and H_2, that the feet a, b, c, d of the altitudes Aa, Bb, Cc, Dd of the tetrahedron $ABCD$ are on the curve of the pencil and that the lines, other than the altitudes, which join the points A, B, C, D to the points a, b, c, d are on a hyperboloid H_1, H_2, or H_3.

III. The hyperboloid H_1 being given, through a point A in space one may pass two hyperboloids H_2 of the second family defined as has been indicated (II); on what surface S must A be found in order that these hyperboloids H_2 coincide? So also through the point A one may pass two hyperboloids H_3 defined as in (II); on what surface S' must A be found in order that these hyperboloids H_3 coalesce?

Show that H_1 cuts S and S' along the same curve C, and that the intersection of S and S' is composed of the curve C and an imaginary curve.

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[1] These questions are solved in *Nouvelles Annales de Mathématiques*, tome 73, oct.-nov., 1914, pp. 491-505.

IV. Construct the projection Γ on the plane xOy of the curve C; show that Γ is the envelope of circles orthogonal to a fixed circle and find the locus of the centers of these circles.

Find the locus of the middle points of the chords of the curve Γ which passes through the origin.[1]

COMPOSITION ON A SUBJECT OF ANALYSIS.

(July 3. Time, 7 hours: 7 a. m. to 2 p. m.)

Being given three rectangular axes of coordinates $Oxyz$, consider the total differential equation (1) $a^2y^3dx+(z-a^2y^3)dy-ydz=0$ where a denotes a given constant.

I. Determine the surfaces that are solutions of the equation (1). These surfaces S are ruled; study their lines of striction and their asymptotic lines.

For each asymptotic line of a surface S, express the torsion as a function of the angle which the binormal makes with the axis Oz.

II. The surfaces S all satisfy a partial differential equation of the first order (E) independent of the numercial value of the constant a. Indicate how one may, by means of the surfaces S, generate all the surfaces Σ that are solutions of this equation.

The surfaces Σ contain in general the axis Ox; determine the exceptional surfaces which do not contain it and indicate their nature.

III. Demonstrate that the characteristic curves of the equation (E) are the asymptotic curves of the different surfaces S, and that they form one of the families of asymptotics of the surfaces Σ. Prove that they can be obtained as contact curves of the surfaces Σ with the right conoids having for axes the parallels to Oz meeting Ox.

IV. Determine the second family of asymptotic lines of the surfaces Σ. Prove that the curves of this second family can be obtained as curves of contact of the surfaces Σ with the right conoids having for axes the parallels to Ox meeting Oz.

Determine the ruled surfaces Σ which are distinct from the surfaces S. Indicate their nature.

V. Suppose T is a surface enjoying the property that one of its family of asymptotic lines is formed from the curves of contact of T with the right conoids having for axes the parallels to Ox meeting Oz. Prove that the surface T either is a ruled surface with director plane parallel to the plane yOz, or else satisfies a partial differential equation of the form (E') $F(z-qy,\ py)=0$, $\left(p=\frac{\partial z}{\partial x},\ q=\frac{\partial z}{\partial y}\right)$.

Show that in the second case the asymptotic lines of the other family are characteristics of the equation (E') satisfied by the surface T, and that these lines can be obtained as curves of contact of the surface T with the right conoids having for axes parallels to Oz meeting Ox.

If two surfaces, of which each satisfies an equation of the form (E'), are tangent in a point, they have at this point the same total curvature.[2]

MECHANICS.

(July 4. Time, 7 hours: 7 a. m. to 2 p. m.)

Motion of a marble in a basin.

A homogeneous spherical marble is let go without initial velocity on the interior hemispherical surface of a fixed basin of which the axis of symmetry is vertical and which is concave upward.

Required to study the motion of the marble on the basin.

In particular solve the following questions concerning this motion:

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[1] **These questions are solved in *Nouvelles Annales de Mathématiques*, tome 74, jan. 1915, pp. 15-29.**

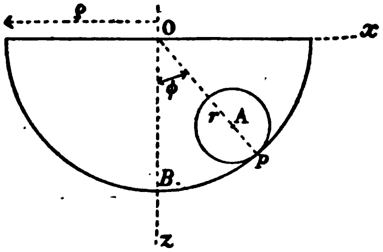
[2] **Idem, tome 73, déc., 1914, pp. 539-547.**

I. Suppose first that the marble can be concentrated at a material point A.

1. Indicate the nature of its motion when the bodies in contact are perfectly smooth.

2. Consider then the case where the coefficient of friction f of the marble on the basin is not negligible. Determine first the condition of equilibrium for an initial determinate position A_0 of A. (Denote by ϕ_0 the initial value, comprised between 0 and $\frac{\pi}{2}$, of the angle ϕ of OA with the downward vertical OZ). When this condition is not satisfied, the point A is changed for a time in a determinate sense on a circle Γ. For the moment confine the calculation to that of the expression for the velocity v of A as a function of the angle ϕ during this interval of time T.

II. Then solve the same questions in the case where the radius r of the marble is not negligible.



But when the slipping friction is appreciable, confine the attention (neglecting the rolling friction) to the case where the marble rolls without slipping from the initial instant. Show that for a given initial position, A_0, of the center A of the marble this condition is necessarily produced if the coefficient of friction f is sufficiently large. (In this case call w the velocity of A, and Ω the instantaneous velocity of rotation of the marble.)

III. Find an approximate value of $\frac{w^2}{v^2}$, w and v being calculated for the same position of OA, very near to the common initial position OA_0 and for the same value of the coefficient f, when the radius r which enters in w^2 is very small.

IV. In a general manner, compare the results obtained in Paragraph I with those of Paragraph II when the radius r of the marble tends toward zero, and the values of ϕ_0 and of f (zero or not) remain the same. It is noted that these results are different; indicate in a few words the origin of this paradox.

V. Return to the case where the marble is reduced to a material point. Show that during the interval of time T the velocity v of the marble supposed rough is less than that, V, which it possesses if it were smooth when it passes through the same point, starting from the same initial position A_0.

VI. Then continue the study of the motion of the marble reduced to a material point and indicate the various circumstances which can present themselves according as the value of f and the position of A_0 (without now limiting ourselves to the case where the interval of time T when the velocity of A does not change the sense).

VII. In particular, indicate what happens when the value ϕ_0 is taken equal to 32°, then to 60°, the coefficient of friction having in the two cases the value 0.75, then the value $\frac{1}{2}$.

Notation: Call ρ the interior radius of the basin, O its center and mg the weight of the marble. It will possibly be found useful to set $\tan\theta=f$ and $\tan\theta'=2f$.

Of the candidates who took the previous examinations, 29 were declared by the jury to be *admissibles.* Further test of each of these by: (1) A numerical calculation; (2) a problem in descriptive geometry (*épure*); and (3) an oral "lesson" occurred on August 21, 1914. This resulted in the final selection of 15 agrégés.

The members of the jury for the entire examination were:

Niewenglowski, inspector general of public instruction, president.
Blutel, inspector general of public instruction, vice president.
Cartan, professor at the University of Paris.
Frechet, professor at the University of Poitiers.
Grévy, professor at Lycée St. Louis.

In 1910 the numerical calculation and épure were as follows:

NUMERICAL CALCULATION.

Calculate the integral

$$I=\int_0^{2\pi}\left(\frac{100-10\cos\alpha}{101-20\cos\alpha}\right)^2 d\alpha$$

The direct method of primitive functions should be employed and it should be compared with the results obtained by the methods of approximate integration. Indicate, in each of these methods, the number of significant figures that are determined with certainty.

DESCRIPTIVE GEOMETRY (ÉPURE).

A parabola P situated in a horizontal plane has for horizontal projection a parabola of which the focus is 96 mm. to the left of the major axis, and 60 mm. below the minor axis of the sheet; its vertex is 102 mm. to the left of the major axis and 54 mm. below the minor axis.

A frontal line D is inclined at 45° to the horizontal plane and it rises from right to left; it passes through the point of the horizontal plane of projection situated at 130 mm. to the right of the major axis and 96 mm. below the minor axis of the sheet. This line is met by the parabola P in a point situated to the right of the profile plane which contains the major axis of the sheet.

Consider the parabolic segment bounded by the arc of the parabola P which contains its vertex and by the parallel to the ground line distant 144 mm.; required to represent in vertical projection only the solid generated by the rotation of this segment about the line D.

Take the minor axis of the sheet for ground line.

SUBJECTS OF THE "LESSONS" IN 1910.

(1) *In Mathématiques Élémentaires.*

Solution of triangles.

$$\left.\begin{array}{l}\text{Symmetry with respect to a point.}\\ \text{Symmetry with respect to a line.}\\ \text{Symmetry with respect to a plane.}\end{array}\right\}\text{(As in the classe de première.)}$$

Variation of $\frac{ax+b}{a'x+b'}$; graphic representation (program of seconde).

Supplementary trihedral angles. Applications.

Rabattments. Applications.—Angle between two lines, angle between a line and a plane, angle between two planes.

Conversion of an ordinary fraction into a decimal fraction. Repeating fractions. (Mathématiques A.)

Volume of parallelepipeds and prisms. (Do not consider the truncated pyramid or the truncated prism.) (Première.)

Plane sections of a cone of revolution. (Dandelin's method.)

Homothetic polyhedra. Similar polyhedra. (Première.)

Relation between the coefficients and the roots of the equation of the second degree. Applications.

Summary of notions on the symmetries of the cube and of the regular octahedron.

Tangents to a hyperbola. Asymptotes. Simple problems on tangents.

Notion of the derivative, geometric significance of the derivative.

Application to the variation of simple functions. (Program of seconde.)

Homothety in plane geometry.

Inversion (in a plane and in space). Applications.

Motion of the moon. Phases.

Problems of the second degree. (Mathématiques A.)

(2) *In Mathématiques Spéciales.*

Small oscillations of a pendulum without friction: Isochronism.

Asymptotes in polar coordinates; position of the curve with respect to its asymptotes.

Theory of envelopes in plane geometry.

Normals to the ellipsoid.

Curvature of plane curves. Evolutes. Examples (rectilinear coordinates).

Motion of a point under the action of a force issuing from a fixed center and proportional to the distance.

Motion of a heavy particle on an inclined plane with or without friction, the initial velocity being zero or directed along the line of greatest slope.

Number *e*. Limit of $\left(1+\frac{1}{m}\right)^m$.

Series of positive terms. Criteria of convergence and divergence derived from study of the expressions:

$$\frac{u_{n+1}}{u_n},\ \sqrt[n]{u_n},\ nu_n{}^p;\ \text{numerical examples.}$$

Complex numbers. $a+bi$. Addition, subtraction, multiplication, division. Geometric representation.

Use of the derivative for the study of the variations of a function; maxima and minima. Numerical examples.

Developments into series. Applications to the series of the binomial and of arcs in x.

Motion of a point attracted by a fixed center in a ratio inversely as the square of the distance.

Construction of a curve ($\rho=f(\omega)$) in polar coordinates. (It should be assumed that the lessons on tangents and asymptotes have been given.)

Discussion of the commensurable roots of an equation with integral coefficients. Examples.

Multiplication of series. Applications.

Power series. Intervals of convergence. Differentiation. Integration.

Intersection of a surface of revolution and a cone.

Trigonometric solution of the binomial equation.

Infinite branches in the intersection of cones and cylinders. (Descriptive geometry)

Intersection of two surfaces of revolution of which the axes are in the same plane.
Symmetric and rational functions of the roots of an algebraic equation.

The jury for the concours of the agrégation in 1910 consisted of:
Niewenglowski, inspector general of public instruction, president.
Hadamard, professor at the Collège de France, vice president.
Combette, inspector general of public instruction.
Grévy, professor at Lycée St. Louis.
Husson, professor at the university of Caen.

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A mimeographed pamphlet (16 pp.) published annually from 1901 to 1913, by the Librairie Croville-Morant, Paris, contained the épreuves écrites and subjects of the "Lessons" for the Agrégation des Sciences Mathématiques of the year.

Published solutions of some of the questions of the agrégation during the four years 1910–1913 may be consulted in the following places:

Agrégation 1910.—Composition in Math. Élém.: *Journal de Math. Elem.*, année 35, mai, 1911, pp. 121–124; Composition in Math. Spéc.: (1) *Rev. de Math. Spéc.*, année 21, juin, 1911, pp. 214–221; (2) *Nouv. Annales de Math.*, tome 70, janvier, 1911, pp. 72–80; Composition in Analyse: *Nouv. Annales de Math.*, tome 70, janvier, 1911, pp. 21–39.

Agrégation 1911.—Composition in Math. Elém.: (1) *Journal de Math. Élém.*, année 36, juin, 1912, pp. 137–140; (2) *Nouv. Annales de Math.*, tome 70, août, 1911, pp. 358–373; Composition in Math. Spéc.: *Revue de Math. Spéc.* année 22, juin, 1912, pp. 512–518; épure: *Revue de Math. Spéc.*, année 22, août, 1912, pp. 576–578; Composition in Analyse: *Nouv. Annales de Math.*, tome 71, mai, 1912, pp. 231–240; Composition in mécanique: *Nouv. Annales de Math.*, tome 71, décembre, 1912, pp. 549–567.

Agrégation 1912.—Composition in Math. Elém.: (1) *Journal de Math. Elém.*, année 37, juin, 1913, pp. 149–154; (2) *Nouv. Annales de Math.*, tome 71, décembre, 1912, pp. 506–528; Composition in Math. Spéc.: *Revue de Math. Spéc.*, année 23, sept., 1913, pp. 289–294; Composition in Analyse: *Nouv. Annales de Math.*, tome 72, juli, 1913, pp. 316–323.

Agrégation 1913.—Composition in Math. Élém.: (1) *Jour. de Math. Élém.*, année 38, juin, 1914, pp. 141–144; (2) *Nouv. Annales de Math.*, tome 73, fév., 1914, pp. 81–89; Composition in Math. Spéc.: (1) *Revue de Math. Spéc.*, année 24, juli, 1914, pp. 553–558; (2) *Nouv. Annales de Math.*, tome 73, juli, 1914, pp. 316–324; Composition in Analyse: *Nouv. Annales de Math.*, tome 73, jan., 1914, pp. 26–34; épreuve pratique: *Revue de Math. Spéc.*, année 24, juli, 1914, pp. 559–561.

The programs for each year are usually published during the preceding July in the *Bulletin administratif du ministère de l'instruction publique.*

APPENDIX E.

GERMANY.

A. REIFEPRÜFUNGEN.

I. WURTTEMBERG.

Questions of a (1) Gymnasium; (2) Realgymnasium; (3) Oberrealschule.

(1) *GYMNASIUM:*

ALGEBRA AND TRIGONOMETRY.

1. Two places M and N are 119 km. apart; A goes from M to N and travels 20 km. on the first day, 18 on the second, etc., B starts from N toward M two days after A's departure and travels 10 km. on the first day, 13 km. on the second, etc. When and where do they meet each other?

2. Solve:

$$x-y=1-z.$$
$$x^2-y^2=\tfrac{7}{3}(1-z^2).$$
$$x^3-y^3=\tfrac{37}{7}(1-z^3).$$

3. A certain capital brought $4\frac{1}{2}$ per cent interest, and, although 420 marks were annually withdrawn, was doubled in 18 years. How large was the capital?

4. Solve the triangle given

$$a=450.34,\ \rho=92.45,\ \rho_a=367.52.$$

[ρ is the radius of the inscribed circle and ρ_a the radius of the escribed circle opposite the angle A.]

PLANE AND SOLID GEOMETRY.

1. Construct a triangle given h_a, t_a and the condition that the projection of t_a on a is equal to $b-c$. [h_a=altitude of triangle from angle A; t_a=length of the median from the angle A.]
2. On a given line segment a, draw two similar rectangles such that the portion of one outside the other is a square.
3. On a given line segment AB a semicircle is described. Find a point X on the diameter AB produced and a point Y on the tangent at A such that XY is divided by the semicircle into three equal parts.
4. A given rectangle $ABCD$ rotates about the side AB as axis. It is required to divide the rectangle into three parts by lines drawn from D such that the solids generated by these parts shall have equal volumes.

(2) *REALGYMNASIUM:*

HIGHER ANALYSIS.

1. Find the value of $\dfrac{(e^x-e^{-x})^2}{x\cos x}$, for $x=0$.

2. The total surface of a cylinder is 924 square meters. What must be its height and the length of the radius of its base in order that the cylinder should have a maximum volume?

3. For the curve $y=x^2(3-x)$ determine the maxima and minima points and point of inflexion, also the equation of the inflexional tangent. Graph the curve. Calculate the area between the curve and the positive $x-$axis.

4. Determine the area bounded by the curves:
$$y^2=-\tfrac{3}{2}(x-8) \text{ and } (x+4)\,(y+3)=36,$$
and lying within the first curve.

ANALYTIC GEOMETRY.

1. Through the vertices B_1 and B_2 of the minor axis of an ellipse and a focus F_1 a parabola is drawn whose axis coincides with the major axis of the ellipse. (*a*) Find the equation of the parabola; (*b*) Construct the tangents to the parabola at B_1 or B_2 and find their equations.

2. The tangent to the ellipse
$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1.$$
at a point P meets the Y-axis in P_2; and the normal at P meets it in P_1. One focus F_1 is joined to P_1, the other to P_2. What is the geometric locus of the point of intersection of $F_1\,P_1$ and $F_1\,P_2$? (F_1 and F_2 on the X-axis.)

3. Consider whether or not the line $y=4x-2$, $z=3x+2$. Cuts the circle
$$x^2+y^2+z^2=30.$$
$$3x-5y+z+2=0.$$

4. Given a sphere with center at the origin and radius equal to 5. A cylindrical surface tangent to this sphere is described with generating line parallel to the line.
$$y=2x,\ z=3x.$$
Find the equation of the cylindrical surface.

(3) *OBERREALSCHULE.*

DESCRIPTIVE GEOMETRY.

A sphere is surrounded by a plane concentric ring (Saturn); the plane of the ring is parallel to the horizontal plane. Construct the shadow of the sphere on the ring, the shadow of the ring on the sphere; the shadow of the sphere on itself, the shadow of the whole system on the horizontal plane. (The light comes from above to the left and is parallel to the vertical plane.) The various measurements are supposed given.

TRIGONOMETRY.

1. In a place A, whose eastern longitude is $\lambda=9^\circ\ 59'$, it was observed on the 19th of June that the sun rose at 24 minutes, 8 seconds past 4 (middle European time) and culminated at 48 minutes, 14 seconds past 5 (star time). Hence determine the geographical latitude of A, the M. E. T. of sunset, and the declination of the sun if the time equation is $+0'\,24''$; and the inclination of the ecliptic is $\epsilon=27^\circ\ 27'\ 10''$.

2. If $\alpha+\beta+\gamma+\delta=360^\circ$, change the expression.
$$\cot\frac{\alpha}{2}+\cot\frac{\beta}{2}+\cot\frac{\gamma}{2}+\cot\frac{\delta}{2}$$
into a product in which δ is lacking.

PHYSICS.

(Mathematical questions only.)

1. A factory power canal 2 meters broad and 1 m. deep is closed by a heavy lock, of weight $G=110$ kg., and raised upward. How many horsepower must an electric motor possess in order to raise the gate entirely out of the water, in $t=3$ seconds, the coefficient of friction of the gate being $f=0.2$.
2. A plane convex lens stands centered opposite a telescope focused to infinity, and with its plane surface next the telescope. A luminous point lying on the other side of the lens, on its axis, is clearly seen in the telescope if it is at a distance $l=16.3$ from the vertex of the curved surface of the lens. What significance has l for the lens? How can the radius of curvature and the position of the principal points be calculated from this, if the thickness of the lens is $d=0.6$ cm. and the refraction quotient is 1.53?

II. HAMBURG.

(1) *WILHELM GYMNASIUM.* Spring, 1909.

1. An ellipse with semi-axes $a=7$, $b=5$ cm. is rotated about (*i*), the axis $2a$ (*ii*), the axis $2b$, and (*iii*), a tangent parallel to a. Compare the volumes of the three surfaces of revolution with one another.
2. Given the function $y=\log \frac{a+x^2}{2bx}$.

   Find the first and second derivatives, and the value of x for which the function is a minimum.
3. A square pyramid is to be circumscribed about a sphere of radius r, so that its volume shall be a minimum. What are the lengths of the edge of the pyramid and of a side of the square base?
4. How high is the sun on the longest day in Hamburg if it is exactly in the west and at what time (local time) does this occur?

Special exercises.[1]

1. $\int_0^8 - 4\sqrt[3]{x^2}dx=?$
2. Integrate $\int e^x . \sin x \, dx$.

(2) *REALGYMNASIUM.* Spring, 1907.

1. *Projective geometry:* The vertices A and A_1 of the major axis of an ellipse are joined to a vertex B of the minor axis; on these lines BA and BA_1, perpendiculars are let fall from the points D and D_1, in which a movable tangent to the ellipse cuts the tangents at the vertices A and A_1. Show that the locus of the point of intersection $\triangle$ of these perpendiculars is a hyperbola, of which the asymptotes are the perpendiculars through A and A_1 to BA and BA_1.
2. *Analytic geometry:* Given a hyperbola with center O and a line s perpendicular to the transverse axis and cutting it at a distance c from O; the polar of a point P_1 of s cuts the diameter $O\,P_1$ in $\triangle$. What is the locus of $\triangle$ as P_1 moves in s?
3. *Cubic equation:* In order to compare the specific heat of copper and lead one wants two quantities of equal superficial area and weight. If a quantity of lead in the form of a cylinder with ends capped by two hemispheres is available, then a similarly formed copper cylinder with hemispheres capping the ends must be

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[1] In practice, as a matter of fact, solutions of special exercises, which are very little harder than others, compensate for failure in one of the required questions. Two faultless solutions of questions are usually necessary and sufficient for the predicate "satisfactory." For "very good," four solutions without error are expected.

formed such that its weight $p=162\pi g$ and surface $O=27\ \pi$ cm.^{2} are equal to the piece of lead. Determine the height of the cylinder and the radius of the end hemispheres if the specific heat of copper is 9 g $cm.^{-3}$.

4. *Differential calculus:* The curve

$$yr^2=\frac{4}{3}\,x\,(r^2-\tfrac{1}{4}\,{}^2x^2)$$

has a point of inflexion, a maximum, and a minimum point. Determine these points and draw the curve.

Special exercises.

(*i*) Solve the first question by analytic geometry.

(*ii*) Solve the second question by pure geometry.

(*iii*) The intrinsic equation of Van der Waals is

$$R\Theta=\left(p+\frac{a}{v^2}\right)(v-b)$$

where p is constant and the absolute temperature Θ is a function of the volume v. For what value of v has the corresponding curve an inflexional tangent? What value must p have in order that the inflexional tangent be parallel to the axis of volume?

(3) *OBERREALSCHULE* (one of four), spring, 1907.

1. Through a payment of 6,000 marks a man 30 years of age purchases life insurance. How much is this insurance on the basis of 4 per cent interest and Schubert's table of vital statistics? What age must the man reach in order that an equal sum would be paid to his heirs from a savings bank in which the 6,000 marks at 3½ per cent had been deposited till the termination of the contract?
2. What regular spherical polygons can be made up of equilateral triangles and how large are the radii of the inner and outer tangent circles of these polygons?
3. Find the first polar of the curve

$$2x^3+2x^2-8x-y+8=0$$

with respect to the origin. Draw the curve and discuss it. Find its intersections with the $x-$axis and the tangents to the curve in these points.

4. What is the value of the difference

$$\int_{\frac{\pi}{4}}^{\frac{\pi}{3}}\frac{2\ \sin x\ -\ \sin 2x}{\cos x}dx-\int_{\frac{\pi}{3}}^{\frac{\pi}{2}}\frac{\cos x-\tan \pi/4}{\sin x}\,dx$$

Special exercises.

(*a*) Find the locus of the vertex of a triangle with given base 2 c and sides of given product p^2?

(1) What is the form of this locus according as p is greater than, equal to, or less than c?

Example for sketching: $c=3$

$p_1=2\sqrt{2},\ p_2=\sqrt{10},\ p_3=3$

(2) In what case is there a double point, and what are the tangents at this double point?

(3) Find the first polars of the point at infinity on the base of the triangle, of the point at infinity on the perpendicular bisector of the base, and also of the middle of the base with respect to the locus in question. Indicate the significance of these lines for the locus, and draw a sketch for the numerical values $c=3$ and $p=2\sqrt{2}$.

(*b*) Evaluate the integral

$$\int_{b:c}^{(b+\sqrt{b^2+ac}):c} \frac{dx}{\sqrt{a+2\,bx-cx^2}}$$

B. LEHRAMTSPRÜFUNGEN.

WURTTEMBERG.

I. Questions in the Mathematics-Physics Division.

HIGHER ALGEBRA.

1. Given the equation

$$x^4+a_1x^3+a_2x^2+a_3x+a_4=0$$

whose roots are all different from one another. Find the equation of the fourth degree in y, which is satisfied by the unsymmetric functions of roots $y=x_1+x_2+x_3$, etc. Prove that the discriminants of the two equations are identical.

2. According to the general interpolation formula find an integral algebraic function y_x (fourth order in x), which for

takes on the values $\begin{matrix} x=0, & 2, & 3, & 6, & 9, \\ y=0, & 0, & 3, & 105, & 630 \end{matrix}$

(Indicate also a second method, without details; evaluate the determinants which here enter.) Further show that the value y_x can be changed into an "Überzweizahl," if for numbers of the form $\binom{n}{r}$ the name "Über-*r*-Zahl" is employed. Write down the values of the numbers y_{-1} to y_9. Further calculation of y_x checked by these values; calculation of the sum y_{-1} to y_x. Checks.

HIGHER ANALYSIS.

1. Evaluate and give the geometric meaning of the double integral

$$\int_0^{2a} \sqrt{\frac{2a-x}{4a-x}}\,dx \int_0^{\sqrt{x(4a-x)}} [\sqrt{x(4a-x)}-y]\,dy;$$

give a plan and elevation sketch.

2. $y=x\left[\frac{dy}{dx}-\left(1-\left(\frac{dy}{dx}\right)^2\right)\right]^{\frac{1}{2}}.$

3. $12xy^2\frac{\partial z}{\partial x}+3y(x^2-2y^2)\frac{\partial z}{\partial y}=2.$

4. Derivation of the properties of the logarithm and of the exponential function in the complex field. Give three examples.

ANALYTIC GEOMETRY.

1. Discuss the curve

$$x^5-x^4y-2x^3y^2+2x^2y^3+xy^4-y^5-2x^4+4x^3y-4xy^3+2y^4-4x^2y+3xy^2-y^3=0.$$

2. Find the equation of the tangent-surface of the space curve $x=\lambda$, $y=\lambda^2$, $z=\lambda^3$ and determine the orthogonal trajectories of the tangents on the surface. Without calculation, what may be stated with regard to the lines of curvature, the asymptotic lines, and the geodetic lines of the surface? (If time is lacking it is only necessary to write the differential equation of the trajectories.)

SYNTHETIC GEOMETRY.

1. Determine the center of a hyperbola given four points and the direction of an asymptote.

2. To four planes through a point *O*, no three of which cut in a straight line, the normals in *O* are given. How may the normal at *O* to any plane through *O* be con-

structed through simply joining and intersection, and in particular without the further use of a right angle?

Descriptive Geometry.

In a vertical plane of projection a semi-ellipse is given, of which the shadow is a semicircle. It is subjected to a rotation in space about a vertical axis. Construct the normal curve and the meridian of the surface of rotation so constructed, i. e., the section of any plane (1) perpendicular to the axis of rotation or (2) through the axis. (Suppose the proportions given.) Give a free drawing in india ink of the two curves sought, also a short description of the corresponding construction.

Analytic Mechanics.

1. On three mutually perpendicular weightless sticks, rigidly fastened together at a point O, "mass-points" P, Q, R are placed at distances a, b, c from O.

The system is turned about an axis through O which at a given instant, when the angular velocity is ω, makes angles α, β, γ with the three sticks.

How great is the *vis viva* of the turning motion of the system at this instant? Through what single force at O and what pair of forces (what axis-moment) may the three centrifugal forces be replaced?

Discussion of the results for the case $\alpha=\beta=\gamma$.

2. The velocities of three noncollinear points of a rigid body moving with freedom of the first order, are given for a certain instant as vectors, i. e., in size and direction. Show how to find, either by drawing or by calculation, for the same instant: (a) the velocity of a fourth point of the body, also considered as a vector, and (b) the central axis or rotation axis, i. e., the locus of the points of the body which, for the instant, of all of its points has the least velocity.

Trigonometry and Mathematical Geography.

1. On two points A and B of equal height and 25 meters from each other rests a smooth thin band of steel which sags 50 centimeters in the middle. How many millimeters (to the nearest tenth of a millimeter) is the band longer than 25 meters?

The calculation is to be carried through, and the exactitude of the result proved, without employing any tables. (The calculation is to be carried through in numbers.)

2. On a simple rod standard a vertical reference-plane F is determined by a strong white endless thread passing through two rings O_1 and O_2, and stretched with the help of a hanging stone O_3. The azimuth of the two directions of the thread differs by exactly 180°. The azimuth is not exactly known, but it corresponds about (according to the compass within 5°) to the prime vertical.

At the point of observation (in middle Germany), determining the northern latitude ϕ on an evening toward the end of November, 1895, the following times of transit through the plane of the thread are observed in siderial time:

γ Lyra (about westward) $S_1=22^h\ 29^m\ 59^s$,
γ Andromeda (about eastward) $S_2=22^h\ 35^m\ 45^s$.

The apparent AR [right ascension] and δ [declination] of the two stars on the evening of observation were:

γ Lyra $\alpha_1=18^h\ 55^m\ 2^s$, $\delta_1=+32°\ 32'.8$,
γ Andromeda $\alpha_2=1^h\ 57^m\ 32^s$, $\delta_2=+41°\ 50'.1$.

What is the northern latitude of the place of observation? What was the azimuth of the plane of the thread? What kind of stars are to be chosen for such determination of the northern latitude by transits through one and the same vertical first eastward and then westward? Calculation of ϕ in numbers is desired.

(The candidate is allowed a logarithm table.)

THEORETICAL PHYSICS.

1. Discussion of the physical foundations of the Newtonian definition of the quantities "force" and "mass."

2. Derivation of the formula of an adiabatic curve.

3. Foundations of a theory of plane diffraction grating for parallel light rays.

4. How and with what exceptions is Helmholtz's law of induction derived on the basis of the law concerning the conservation of energy?

II. Mathematical Questions of the Chemistry-biology Division.

ALGEBRA AND LOWER ANALYSIS.

1. A merchant buys wares for a certain sum, has in addition 5 per cent expenses, and sells them again for 504 marks, and thereby gains a twentieth part of the purchasing price. What did this amount to?

2. A left a fortune of 100,000 marks. From this his children must receive 6,810 marks annually for 10 years from the first payment within a year after his death. The capital after 10 years is to be devoted to school purposes. How large will this amount be?

3. Express the fraction $\frac{218}{299}$ as the sum of two positive fractions with denominators 13 and 23. What are possible solutions?

4. In the equation $x^4-11x^3+px^2+qx-60=0$ the root $2+i$ is given. Find the other roots and the coefficients p and q. (Check by means of Horner's method).

DIFFERENTIAL AND INTEGRAL CALCULUS.

1. $\lim\limits_{x=0}\dfrac{(e^x-e^{\sin x})}{(x-\sin x)}=?$

2. Express $y=\log(x+\sqrt{1+x^2})$ as a power series in x and discuss the convergence of the series.

3. Given the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}-1=0.$

Through the origin and with different points of the hyperbola as centers, circles are described. Find the equation of the envelope of these circles.

ELEMENTARY GEOMETRY.

1. Describe a circle which touches a given line in a given point P and cuts a given circle K at the ends of a diameter. (Analysis, construction, proof.)

2. Given a point and two lines L and L', which cut one another in A. On L find a point X such that the perpendicular XY from X on L' is a mean proportion between AY and PX. (Construction and proof.)

3. Given a right circular cone of which an axial section is an equilateral triangle. Produce the surface beyond the circular base, such that the whole surface of the added conical shell is to the surface of the whole cone as 5 is to 6 (including construction of the calculated result).

4. B and C are the middle points of two spheres of radii r_1 and r_2 (10 and 14 cm.). To an observer at A the spheres appear under angles of sight S_1 and S_2 (3° 37′ 20″ and 4° 16′ 30″). Angle BAC is 71° 4′ 40″. How great is the distance between B and C, and how large are the angles ABC and ACB?

ANALYTIC GEOMETRY.

1. The curve with equation

$$x^3-2x^2y+2y^3-y^2x-4y^2+2xy-x+2y=0$$

breaks up into three lines, of which one is $x-2y$. What are the equations of the other two? What are the coordinates of the vertices of the corresponding triangle; find its area.

2. In the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}-1=0$ a diameter with slope μ is given. What is understood by a diameter conjugate to this diameter and how is the slope μ' of this diameter derived? How large are the semi-diameters corresponding to these two directions?

3. Discuss and sketch the curve with equation

$$x^3+y^2x-2x^2+y^2=0.$$

4. Given a circle of radius r and a line which is at a distance a from the middle point of the circle. A second circle touches the line in its intersection with the line drawn through the middle point of the first circle perpendicular to the line; the common tangents of the circles touch the second circle in points, the locus of which is required. (The given line is to be taken as x—axis, and the foot of the perpendicular as origin of coordinates.)

DESCRIPTIVE GEOMETRY.

An ellipse is projected horizontally as a circle of 10 cm. diameter, vertically as a line (30° toward the right with the base line). The horizontal trace of a given plane makes an angle of 60°, the vertical trace of 45°, both toward the right with the base line. Construct the shadows of the ellipse on these planes. (Both projections of rays of light coming from the left make angles of 45° with the base line.)

The two projections of the shadows are to be constructed independently of one another; at any given point construct the tangent and find the nature of the curve in order that its conjugate diameters can be determined.

EXPERIMENTAL PHYSICS.

1. A locomotive weighing 20,000 kilograms moves on a track 1$\frac{9}{16}$ meters wide and its center of gravity is 1$\frac{1}{3}$ meters above the rails: what is the greatest velocity that the locomotive may attain in order that, on a curve of 80 meters radius, it shall not leave the rails? What is the maximum velocity, if the outer rail be so raised that the plane of the rails is inclined to the horizontal plane with an angle of 5°?

2. For determining the temperature of a smelting furnace, a platinum sphere of 100 grams is put in it and then thrown into a mixing calorimeter which contains 800 grams of water at 10° C. What is the temperature of the furnace if the brass calorimeter tub weighed 250 grams and the final temperature reached 14.8°? (Specific heat of brass, 0.0926; of platinum, 0.0326.)

3. Two biconvex lenses with focal lengths f_1=4cm. and f_2=6cm. are arranged from left to right, such that the distance of their optical middle point amounts to δ=1 cm.; the thickness of the lenses may be neglected. To the left of the first lens is a luminous substance AB 1 cm. high. Construct the picture of the object which is thrown through the pair of lenses and also determine the distance b_1 of the picture from the second lens. How great is the common focal distance f of the system of lenses counted from the second lens; and what advantage is there in such a combination of lenses over a simple lens with the same focal distance?

APPENDIX F.

JAPAN.

The following mathematical papers were set in Tokyo for the twenty-fifth examination for teachers' licenses, in 1911.

PRELIMINARY EXAMINATION QUESTIONS.

Arithmetic (3 hours).

1. Find three fractions, A, B, and C equal to $\frac{3}{5}$, $\frac{4}{9}$, and $\frac{6}{11}$, respectively, such that A's denominator is equal to B's numerator, and B's denominator to C's numerator. Find the simplest forms of such three fractions.

2. A certain company, dividing its capital in the ratio of 3 : 5 : 7, carried on its business in three divisions. At a semiannual settlement it was found that the first division had made 2,600 yen, and the second had earned 8 per cent a year on its capital, but that the third had suffered a loss of 5 per cent a year of its capital. However, the net result was found to be a gain of 6 per cent a year on the total capital. What was the amount of the capital?

3. A steamer, bound for a certain port, had its engine damaged when one-fifth of its voyage had been completed. As it had to reduce its speed by 10 knots for the rest of its course, the average speed was found to be less than the first by 4 knots. What was the initial speed?

4. By evaporating 600 grams of water containing 3 per cent of salt, one containing 5 per cent of salt was to be obtained. It was found, however, that 70 per cent of the water had already evaporated. How much water containing 3 per cent of salt must be added in order to obtain the solution of required strength?

5. Of a cylindrical vessel holding one *shō*, the height and diameter of which are equal, find the height to the hundredth place.

Algebra (3 hours).

1. When $a+b+c=0$, prove

$$\left(\frac{b-c}{a}+\frac{c-a}{b}+\frac{a-b}{c}\right)\left(\frac{a}{b-c}+\frac{b}{c-a}+\frac{c}{a-b}\right)=9.$$

2. Solve and discuss the following simultaneous equations:

$$ax-by-z+1=0, \qquad x+y-az-b=0, \qquad x+y-z+1=0.$$

3. Cut a triangle and a rectangle, having equal bases on a straight line, by another straight line [parallel to it][1] so that the sum of the areas cut out between the parallel lines shall be equal to the area of the triangle. Find the distance between the parallel lines.

4. In how many different ways can 10 balls be arranged in a straight line, provided that 2 special balls must in all cases be placed so as to occupy alternate positions?[2]

5. Let a_1, a_2, a_3, ... be an arithmetic progression, and b_1, b_2, b_3, ... be a geometric having all its terms positive. Prove that a_n is not greater than b_n, if $a_1=b_1$ and $a_2=b_2$.

---

[1] These words do not occur in the original.

[2] It is not clear what is meant by "alternate positions."

GEOMETRY (3 hours).

1. Let two circles touch internally at A. From any point P in the circumference of the external circle draw a tangent PM to the internal one, and prove that $PA:PM$ is constant.

2. Given a vertical angle, the radius of the inscribed circle, and the area, construct the triangle.

3. The vertex A of the rectangle $ABCD$ is a fixed point, and B and D are on the circumference of a fixed circle. Find the locus of the point C.

4. Find the limit of the position of a point, the ratio of whose distances from two fixed points is less than a given ratio.

5. Of a quadrilateral whose four vertices are not all in one plane, three are fixed and one moves along a straight line. Find the locus of the intersection of the lines joining the middle points of its opposite sides.

FINAL EXAMINATION QUESTIONS.

ARITHMETIC, ALGEBRA, AND GEOMETRY (written).

Part I (3 hours).

1. The sum of a certain irreducible fraction and its reciprocal is equal to $\frac{138794}{400115}$. Find the irreducible fraction.

2. Eliminate x, y, and z from

$$\frac{x}{a}+\frac{a}{x}=\frac{y}{b}+\frac{b}{y}=\frac{z}{c}+\frac{c}{z},$$

$$xyz=abc,$$

$$x^2+y^2+2(ab+bc+ca)=0.$$

3. If a, b, p, and q be real, prove that the following equation has real roots,

$$\frac{p^2}{a+x}+\frac{q^2}{b+x}-1=0.$$

4. Solve the following inequality, $x-b>\sqrt{a(a-2x)}$, where a and b are positive, and $\sqrt{}$ represents the positive square root.

5. Prove that the following three equalities are consistent with one another,

$$x=10^{\frac{1}{1-\log z}}. \qquad y=10^{\frac{1}{1-\log x}}, \qquad z=10^{\frac{1}{1-\log y}},$$

log representing the common logarithm.

Part II (3 hours).

1. If rectangles $ABDE$, $ACFG$ be externally constructed on the two sides AB and AC of the right angle A of a right-angled triangle ABC, prove that the straight lines BF and CD intersect with each other on the perpendicular from A to the hypotenuse BC.

2. Draw a circle with its center on a straight line passing through the center of a given circle, intersecting this circle at right angles and passing through a given point.

3. Of a triangle ABC, the vertex A is a fixed point on an edge of a trihedral angle and the other two vertices B and C move respectively along two other edges. Find the locus of the center of gravity of the triangle.

ARITHMETIC (oral).

A boat is rowed over a certain distance, when there is no tide, in 24 hours. With the tide, however, the same distance can be rowed over in 15 hours. Against the tide the boat can be made to go over 32 knots[1] in 2 hours. Find the speed, accordingly, when it is rowed with the tide.

ALGEBRA (oral).

Solve the following simultaneous equations,

$$(1+2k)\,x-(1+k)y=1-k,$$

$$3\,(1+k)\,x-(3+k)y=3+k.$$

GEOMETRY (oral).

Draw a straight line meeting two straight lines not in the same plane and normal to a given plane.

TRIGONOMETRY (written).

Theory (3 hours).

1. Solve and discuss the following equation,

$$\sin 3x=m \sin x.$$

2. Eliminate θ and φ from

$$c \sin \theta=a \sin (\theta+\varphi),$$

$$a \sin \varphi=b \sin \theta,$$

$$\cos \theta-\cos \varphi=2m.$$

3. Find the maximum value of

$$\frac{\operatorname{cosec}^2\theta-\tan^2\theta.}{\cot^2\theta+\tan^2\theta-1}$$

4. If the length of three bisectors of the three angles, A, B, C of a triangle ABC be respectively equal to p, q, r, prove that

$$\frac{\cos\frac{A}{2}}{p}+\frac{\cos\frac{B}{2}}{q}+\frac{\cos\frac{C}{2}}{r}=\frac{1}{a}+\frac{1}{b}+\frac{1}{c}$$

5. Having given one angle, the perimeter, and the radius of the circumscribed circle of a triangle; solve the triangle.

Application (3 hours).

When the three sides of a triangle are known to be respectively,

a=750.74 m., b=596.42 m., c=204.68 m.,

compute the three angles and the area.

ANALYTIC GEOMETRY (3 hours).

1. Given a point (1, 1) and a straight line $3x+4y-6=0$, the axes being rectangular. Form the equation of the curve of the second degree, having the point and the straight line for its corresponding focus and directrix and 5 for its eccentricity, and reduce it to the standard form.

---

[1] Such is the original.

2. Let N be the point of intersection of the normal at any point M on an ellipse and its major axis. Prove that the orthogonal projection of MN on the line passing through M and one of the foci is constant.

3. Prove that the four vertices of a parallelogram circumscribing an ellipse and its two foci are on the same equilateral hyperbola.

4. Given an ellipse and a circle concentric with each other, the radius of the circle being equal to the sum of half the major axis and half the minor axis of the ellipse. Prove that the locus of the point of intersection of the two normals to the ellipse at the points at which two tangents are drawn to the ellipse from any point on the circle is a circle.

5. Let N be the point of contact at which a tangent is drawn from the center M of a fixed circle to the circumscribed circle of a triangle self-conjugate with respect to the fixed circle. Prove that MN is constant.

DIFFERENTIAL AND INTEGRAL CALCULUS (4 hours).

1. If $f'(x).\ \varphi(x)-f(x).\ \varphi'(x)\neq 0$ within the interval $a \leqq x \leqq b$, and $f(a)=0$, $f(b)=0$, then prove that $\varphi(x)$ will become zero within the given interval at least once. Here $f'(x)$ and $\varphi'(x)$ are continuous within the given limits.

2. Let Y be the point at which the line passing through any point X on the diagonal AC of a parallelogram $ABCD$ and the vertex B intersects the side AD or its extension. Find the minimum of the sum of the areas of the two triangles AXY and BXC.

3. Take z as the function of two independent variables x and y; substitute

$$x=r\sin\theta\cos\varphi, \qquad y=r\sin\theta\sin\varphi,^{1} \qquad z=r\cos\theta$$

in $\sqrt{1+\left(\frac{dz}{dx}\right)^2+\left(\frac{dz}{dy}\right)^2}$; taking θ and φ as independent variables eliminate x, y, z.

4. $B(l, m)$ represents $\int_0^1 x^{-1}(1-x)^{m-1}\,dx$, l and m being positive.

Prove that

$$B(l,m)=\frac{l+m}{l}B(l+1,m).$$

5. Find the whole length of the space curve represented by the equations

$$ax=z\,(b+z), \qquad a^2(x^2+y^2)=b^2 z^2,$$

a and b being positive.

6. Take $x=\varphi(u,v)$ and $y=\theta(u,v)$, and change the variables of integration in

$$\int\int dxdy \text{ from } x,y \text{ to } u,v.$$

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[1] In the report this equation is given as $y=r\sin\phi$.

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MONTHLY RECORD OF CURRENT EDUCATIONAL PUBLICATIONS.

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CONTENTS.—Proceedings of associations—Educational history and biography—Current educational conditions—Educational theory and practice—Child study—Educational tests and measurements—Special subjects of curriculum—Kindergarten and primary school—Rural education—Secondary education—Teachers: Training and professional status—Higher education—School administration—School management—School architecture—Physical training—Play and playgrounds—Social aspects of education—Moral education—Religious education—Manual and vocational training—Vocational guidance—Agricultural education, School gardens—Home economics—Professional education—Civic education—Military education—Education of women—Negro education—Exceptional children—Education extension—Libraries and reading.

NOTE.

This office can not supply the publications listed in this bulletin, other than those expressly designated as publications of the Bureau of Education. Books, pamphlets, and periodicals here mentioned may ordinarily be obtained from their respective publishers, either directly or through a dealer, or, in the case of an association publication, from the secretary of the issuing organization. Many of them are available for consultation in various public and institutional libraries.

Publications intended for inclusion in this record should be sent to the library of the Bureau of Education, Washington, D. C.

PROCEEDINGS OF ASSOCIATIONS.

760. **Association of colleges and secondary schools of the Southern states.** Proceedings of the twenty-second annual meeting, Durham, N. C., November 16–17, 1916. 110 p. 8°. (Walter Hullihen, secretary, University of the South, Sewanee, Tenn.)

Contains: 1. B. E. Young: "Taking stock," p. 27–37. 2. N. P. Colwell: Mutual interests of medical and general education, p. 38–45. 3. Harrison Randolph: The old education and the new, p. 46–59. 4. H. A. Hollister: Cooperation in the standardization of secondary schools, p. 60–68. 5. H. D. Campbell: College credit for elementary work in modern languages, p. 69–75. 6. J. L. Manahan: Educational tests and educational administration, p. 76–84. 7. H. M. Gass: Military training in secondary schools, p. 85–95. 8. Elizabeth A. Colton: The junior college problem in the South, p. 96–100. 9. W. P. Few: A new emphasis in education, p. 101–106.

761. **National education association.** [Proceedings, 1916.] Journal of the National education association, 1: 737–888, April 1917.

Department of science instruction.—Contains: 1. C. G. Rathmann: The value and importance of the school museum, p. 737–41. 2. A. W. Abrams: Collection, organization, and circulation of visual aids to instruction by state bureaus, p. 741–45.

Department of child hygiene.—3. S. Josephine Baker: The work of the New York city bureau of child hygiene, p. 747–51. 4. D. B. Armstrong: Social aspects of school hygiene, p. 751–54. 5. F. I. Cooper: Schoolhouses and the fire hazard, p. 759–62. 6. Isabel M. Stewart: The teaching of home nursing and the care of children to elementary- and high-school pupils, p. 762–66. 7. Taliaferro Clark: The physical care of rural-school children, p. 766–70. 8. W. S. Small: Cooperation in health administration, p. 771–73. 9. I. H. Goldberger: The New York system of school hygiene, p. 773–77.

Department of school patrons.—10. Frances E. Harden: The teacher's responsibility as a civic factor in the community, p. 779–81. 11. Elsa Alsberg: Education of the immigrant, p. 781–87. 12. Elizabeth McManus: Social service in the public schools, p. 792–96. 13. Josephine Beiderhase: Administration and method in high-school physical training for girls, p. 796–800. 14. J. E. West: The Boy scouts of America, p. 800–5.

Department of special education.—15. G. L. Berry: Saving the sight of school children, p. 816–19. 16. R. O. Johnson: Measurement of efficiency in schools for the deaf, p. 831–36. 17. Ruth True: The work of the visiting teacher, p. 851–53. 18. Alma M. Bullowa: The need of speech work in the high schools, p. 865–68. 19. Margaret Knox; The principal's point of view of the selection of children for special classes, p. 872–74. 20. L. M. Terman: The Binet scale and the diagnosis of feeble-mindedness, p. 874–77. 21. J. G. Riggs: Training of teachers for special classes, p. 879–81. 22. Ada M. Fitts: How to fill the gap between the special classes and institutions, p. 884–87.

762. **Pennsylvania educational association.** Proceedings of the twenty-second annual convention, Harrisburg, Pa., February 8–9, 1917. Pennsylvania school journal, 65: 429–81, 493–515, April, May, 1917.

Directors' department.—Contains: 1. W. W. Evans: Mobilizing for community welfare, p. 432–35. 2. Eugene Barnako: Americanization of foreigners, p. 435–38. 3. J. M. Coughlin: Continuation schools, p. 439–42. 4. S. C. Schmucker: Moral training through the conduct of the school, p. 442–43. 5. Arthur Holmes: The dollar value of education, p. 449–53. 6. Samuel Hamilton: Plea for play as a method of education, p. 454–62. 7. R. C. Shaw: Advantages of local control in school affairs, p. 462–65.

High school department.—8. J. L. Thalman: The role of the principal as organizer, p. 495–98. 9. Mabel E. Mulock: Advantages of department organization in large high school, p. 498–500. 10. Claire M. Conway: Intra-class-room organization, p. 501–502. 11. J. F. Steele: Junior high school in operation, p. 503–506. 12. C. E. Beard: Efficient democracy, p. 506–10. 13. L. W. Rapeer: A core curriculum for high-schools, p. 510–14.

EDUCATIONAL HISTORY AND BIOGRAPHY.

763. **Florer, W. W.** Luther's attitude toward language study. Monatshefte für deutsche sprache und pädagogik, 18: 139–44, May 1917.

To be concluded.

764. **Reigart, John Franklin.** The Lancasterian system of instruction in the schools of New York city. New York city, Teachers college, Columbia university, 1916. 105 p. illus. 8°. (Contributions to education, no. 81.)

Bibliography: p. 102–105.

The author's purpose is to trace the part played by the monitorial or Lancasterian system which was adopted at the foundation of the free schools of New York city, and was in use with modifications for half a century.

CURRENT EDUCATIONAL CONDITIONS.

765. **Bagley, W. C.** Are the older "school virtues" obsolescent? Journal of education, 85: 451–54, April 26, 1917.

A paper read at the Kansas City meeting of the Department of superintendence, N. E. A., February 28, 1917.

Says that it may be, when we are asked to exchange for the new ideal the older school virtues of obedience, duty, discipline, and thoroughness, we shall decide that, valuable as the new acquisition may prove to be, the price is too high.

766. **Bourne, Randolph.** Education and living. New York, The Century co., 1917. 236 p. 12°.

"Glimpses and paraphrases of new tendencies in the American school and college." Composed from the point of view of the educational philosophy of John Dewey.

767. **Burrows, Ronald M.** The root fault in the English attitude to education. Contemporary review, 111: 579–87, May 1917.

Speaks of the Philistine attitude of the nation as a whole to education itself. Discusses the antagonism of scientists and classicists.

768. **Cooper, Clayton Sedgwick.** Porto Ricans at school. Educational foundations, 28: 474–81, April 1917.

769. **Crooks, Ezra B.** Our schools and national preparedness. Virginia journal of education, 10: 425–28, May 1917.

"The part which the schools can best take for national defense is to train citizens so that they will be in the best condition to do promptly and efficiently what may be required of them."

770. **Cubberley, Ellwood P.** Obstacles to educational progress. Science, n. s. 45: 369–76, April 20, 1917.

771. **Davenport, Frederick M.** Revolutionary tendencies in the school system of the United States. Outlook, 116: 59–60, May 9, 1917.

A critical review of elementary education as exemplified in the schools of New England.

772. **Gray, Herbert Branston** *and* **Turner, Samuel.** Eclipse or empire? London, Nisbet & Co. [1916] 316 p. 12°.

Advocates a new system of national education in order to preserve Great Britain's industrial supremacy.

773. **Hu, Irving T.** The present system of Chinese education. Liu mei tsing nien; the journal of the Chinese students' Christian association in North America, 3: 172–81, May 1917.

774. **Jastrow, Joseph.** The democratic suspicion of education. Educational review, 53: 433–46, May 1917.

Among other things says that "the strangest manifestation of the democratic suspicion of education is the complaint that the educational interests do not remain free from the taint of political influence which democracy has itself imposed."

775. **Léon, Xavier.** Les Pupilles de l'école publique. Revue pédagogique, 70: 121–62, February 1917.

A description of an association, with branches in almost all the departments of France, to give "assistance matérielle et morale" to the orphans of the war.

776. **Petit, Édouard.** Le Congrès de Milan. École et guerre (30 oct.–2 nov. 1916) Revue pédagogique, 70: 22–36, January 1917.

Description of a congress for popular education held by educators of France and Italy. The first was held in Rome, the next will be held in Paris.

777. **Richardson, B. C.** A plea for a national system of education for America. School and home education, 36: 254–56, May 1917.

Advocates a national system of education, supervised by a secretary of education, directed by a national commission and counseled by a national advisory board.

778. **Roger, Maurice.** L'exposition d'éducation populaire de Milan. Revue pédagogique, 70: 37–55, January 1917.

Describes the exposition held by the Union italienne d'éducation populaire in connection with the congress on popular education at Milan.

779. **Smith, Henry Lester.** A survey of a public school system. New York city, Teachers' college, Columbia university, 1917. 304 p. Tables. 8°. (Contributions to education, no. 82.)

A survey of Bloomington, Indiana, schools.

780. Types of schools for boys. Indianapolis, The Bobbs-Merrill company [1917] 318 p. 16°. (Childhood and youth series.)

CONTENTS.—The American academy, by A. E. Stearns.—Military schools in America, by L. R. Gignilliat.—The manual-training high school, by M. H. Stuart.—The church school, by Eric Parson.—The English public school, by J. J. Findlay.

781. **Van Riper, B. W.** On radicalism in education. School and society, 5:520–25, May 5, 1917.

Discusses the general antipathy toward the traditional subjects and the claims put forth for the utilitarian in education.

EDUCATIONAL THEORY AND PRACTICE.

782. **Patri, Angelo.** A schoolmaster of the great city. New York, The Macmillan company, 1917. 221 p. 12°.

CHILD STUDY.

783. **Dearborn, George Van Ness.** Preventing bad habits. Mother's magazine, 12:536, 574–76, June 1917.

Preventing bad habits in children.

784. **Woodburn, E. C.** Ideals in children. South Dakota educator, 30:7–9, May 1917.

Discusses physical ideals, personal ideals of attainment and social ideals.

EDUCATIONAL TESTS AND MEASUREMENTS.

785. **Bourne, Randolph.** Experimental education. New republic, 10:345–47, April 21, 1917.

Defines "experimental education" in the light of the new standard tests in the fundamental subjects by which the work of large masses of public school children is being regularly measured and compared. Discusses the value of mental tests.

786. **Bowler, Alida C.** A picture arrangement test. Psychological clinic, 11:37–54, April 15, 1917.

A test designed primarily to measure logical judgment.

787. **Courtis, S. A.** The problem of measuring ability in silent reading. American school board journal, 54:17–18, 81, May 1917.

Address to the National association of directors of research, Kansas City, Mo., March 1, 1917.

788. **Judd, Charles H.** Educational standards. Journal of education, 85:507–8, May 10, 1917.

"This is the first part of Dr. Judd's paper as read at the Department of superintendence at Kansas City, February 28, 1917 . . . His view of the value of standardization."

789. **McCall, William Anderson.** Correlation of some psychological and educational measurements, with special attention to the measurement of mental ability. New York city, Teachers college, Columbia university, 1916. 87 p. tables. 8°. (Contributions to education, no. 79.)

Bibliography: p. 69–70.

The author examined two classes in a grade school for the basis of his conclusions, "which are necessarily so meagre that universal validity can scarcely be claimed for any of them." The object of the study was to form some basis for estimating the value of certain tests in determining general mental ability.

790. **Myers, Garry C.** Confusion in recall. Journal of educational psychology, 8:166–75, March 1917.

"Many instances of confusion in recall are cited from the classroom, and the amount of confusion in the delayed recall of a simple association experiment is quantitatively determined for normal, high, and elementary school pupils. Confusions in immediate recall ranged from 30 to 40 per cent; in recall after one day, from 40 to 50 per cent; recall after three weeks, 65 per cent; and recall after six months, 85 per cent."

791. **Otis, Arthur S.** A criticism of the Yerkes-Bridges point scale, with alternative suggestions. Journal of educational psychology, 8:129-50, March 1917.

"Presents an analytic and constructive discussion of the terms 'intelligence,' 'mental age,' 'brightness,' 'intelligence quotient,' and 'coefficient of brightness'; considers the selection of tests for an intelligence scale, and the scoring and combination of the results of the tests; outlines an absolute point scale of intelligence; shows how the Binet scale may be converted into a point scale; and raises specific objections to the Yerkes-Bridges point scale."

792. **Rugg, H. O.,** *and* **Clark, J. R.** A cooperative investigation in the testing and experimental teaching of first-year algebra. School review, 25:346-49, May 1917.

793. **Schmidt, William Anton.** An experimental study in the psychology of reading. Chicago, Ill., The University of Chicago press [1917] iv, 126 p. illus., plates, diagrs. 8°. (Supplementary educational monographs pub. in conjunction with the School review and the Elementary school journal. vol. 1, no. 2; whole no. 2. April 1917)

Published also as thesis (Ph. D.) University of Chicago, 1916.
Contains bibliographies.

794. **Shroy, John L.** Standardizing judgments in composition marking. Current education, 21:124-26, 128, 130-31, April 1917.

795. **Stone, Cliff W.** Standardized reasoning tests in arithmetic and how to utilize them. New York city, Teachers' college, Columbia university, 1916. 24 p. 8°.

796. **Terman, Lewis M.** A trial of mental and pedagogical tests in a civil service examination for policemen and firemen. 17-29 p. 8°.

Reprinted from the Journal of applied psychology, 1:17-19, March 1917.

797. **Thurstone, L. L.** A statistical method for the treatment of school survey data. School review, 25:322-30, May 1917.

Says that much research work remains to be done before the educational tests will be sufficiently standardized to be considered satisfactory for extensive work. Makes the point that in "the educational tests and in the percentile arrangement of teachers according to the average scores obtained by their classes, we have available a method which, even in its present form, would be of great service in the inspectorial work of our public schools." Data for the study were based on material obtained from the Des Moines annual report, 1915.

798. **Woodrow, Herbert.** Practice and transference in normal and feeble-minded children. Journal of educational psychology, 8:85-96, 151-65, February, March 1917.

799. **Yerkes, Robert M.,** *and* **Burtt, Harold E.** The relation of point-scale measurements of intelligence to educational performance in college students. School and society, 5:535-40, May 5, 1917.

800. **Yocum, A. Duncan.** Definiteness in educational terminology. School and society, 5:481-87, April 28, 1917.

SPECIAL SUBJECTS OF CURRICULUM.

801. **Central association of science and mathematics teachers.** Proceedings of the sixteenth meeting . . . held at the University of Chicago, December 1-2, 1916. (A. W. Cavanaugh, secretary, Lewis institute, Chicago, Ill.)

Contains: 1. David Snedden: The high school of to-morrow, p. 7-21. 2. C. H. Lane: Aims and methods of project work in secondary agriculture, p. 30-35. 3. L. H. Pammel: The organization of a course in botany in the high school as a preparation for subsequent courses in agriculture, p. 53-57. 4. T. W. Galloway: The first course in zoology: its aims, p. 58-65. 5. Jerome Isenbarger: A first course in zoology in the high school—content and organization, p. 68-73. 6. B. J.

Rivett: Commercial and industrial demands on the chemistry of to-morrow, p. 86–90. 7. Report of the committee on correlation of courses in home economics and chemistry as taught in high schools, p. 95–98. 8. C. R. Dryer: The scope and method of high school geography, p. 114–24. 9. Carrie A. Lyford: Adapting home economics courses to community needs, p. 134–39. 10. Anna McMillan: Content of domestic art courses, p. 139–44. 11. E. R. Breslich: Report of committee on geometry, p. 150–56. 12. G. A. Miller: Modern developments in elementary and secondary mathematics, p. 161–71. 13. Edna Allen: Report of committee on the correlation of mathematics, p. 171–82. 14. K. G. Smith: Report of committee on vocational mathematics, p. 183–88. 15. G. W. Stewart: Physics in the high school of to-morrow, p. 195–206.

802. **Bigelow, Maurice A.** Science in the modern school. Teachers college record, 18: 134–40, March 1917.

Notes of an address before the education section of the Women's city club of New York, November 1916.

"Natural science in the modern school must be arranged and presented with continuous emphasis on its applied aspects."

803. **Bryce, James,** *Viscount*. The worth of ancient literature to the modern world. Fortnightly review, 101: 551–66, April 1917.

Annual presidential address to the Classical association (England), January 8, 1917. A plea for the retention of the classics in the case of pupils showing particular aptitude for them.

804. **Chapman, J. Crosby.** Function of Latin in the curriculum. Educational review, 53: 483–89, May 1917.

Says that Latin will always have "an honored place in the humanities, and consequently in the schools, but it will exist for the chosen few."

805. **Davis, William H.** The teaching of English composition: its present status. English journal, 6: 285–94, May 1917.

Emphasizes the value of a printing outfit as an adjunct to oral and written work in the secondary schools.

806. **Dolbee, Cora.** The relation of the elementary English course to the secondary school course. Educational administration and supervision, 3: 207–24, April 1917.

Discusses the overlapping in the English work in elementary and high schools and tells what Wichita, Kans., has done toward reorganizing the course of study so that the elementary course will be a comparatively secure foundation for the high-school course.

807. **Frayer, William A.** The elementary college course in history. Educational review, 53: 447–58, May 1917.

Says: "The primary purpose of an elementary college course . . . is sound historical instruction, not the teaching of ethics, economics, civics, patriotism, or vocational training."

808. **Garrett, Laura B.** Study of animal families in schools. New York, Bureau of educational experiments, 1917. 19 p. illus. 8°. (Bureau of educational experiments. Bulletin no. 2.)

809. **Greenlaw, Edwin.** English in modern education: aims and methods. School and society, 5: 451–59, April 21, 1917.

A paper read at the annual meeting of the National council of teachers of English, New York, December 1, 1916.

810. **Gregg, F. M.** Courses of study and outlines in sanitation and hygiene for the schools of the state. Lincoln, Department of public instruction, 1916. 44 p. 8°. (Nebraska educational bulletin. Special edition, December 1916. Vol. 2, no. 3.)

811. **Grummann, Paul H.** The teaching of vocabulary. Monatshefte für deutsche sprache und pädagogik, 18: 136–39, May 1917.

812. **Hamel, Augustin.** La nomenclature grammaticale. Revue universitaire, 26:260–70, April 1917.

A criticism of the décret of July 25, 1910, of the University on grammatical nomenclature.

813. **Hosic, James Fleming.** English in the normal school. School and society, 5:571–76, May 15, 1917.

A paper read before the Department of superintendence of the National education association at Kansas City, February 27, 1917.

814. **Jones, Easley S.** Ideas for narration. Illinois association of teachers of English bulletin, 9:1–36, April 1, 1917.

Gives a list of subjects to be used in theme writing showing how the narrative element may be introduced.

815. **Lenney, Teresa M.** Public school thrift: a practical development. American review of reviews, 55:513–16, May 1917.

816. **Lott, Dwight W.** The conscious development of scientific ideals in secondary science education. School science and mathematics, 17:417–26, May 1917.

817. **McKinley, Albert E.** The war and history teaching in Europe. History teacher's magazine, 8:143–47, May 1917.

818. **Manchester, Frederick A.** Freshman English once more. English journal, 6:295–307, May 1917.

Address delivered before the English section of the central division of the Modern language association of America, December 28, 1916.

Stresses proper habits of reading and acquiring a real interest in the study of literature.

To be continued.

819. **Meister, Ludovic.** L'enseignement du français en Alsace. Revue pédagogique, 70:163–71, February 1917.

Tells of the pedagogical difficulties encountered in introducing French into the schools of Alsace.

820. **Millikan, R. A.** Science in the secondary schools. School science and mathematics, 17:379–87, May 1917.

An address read before the Lake Superior teachers' association, September 18, 1916.

821. **Moulton, R. G.** The study of literature and the integration of knowledge. University record, 3:89–104, April 1917.

Some suggestions on the relation of the study of literature to the rest of the field of knowledge.

822. **Parsons, Florence M.** Courage in education: an elementary school experiment. Ninteenth century, 81:871–82, April 1917.

Method of teaching literature in certain English schools.

823. **Shelford, Victor E.** Suggestions as to field and laboratory instruction in the behavior and ecology of animals, with descriptions of equipment. School science and mathematics, 17:388–409, May 1917.

Contribution from the zoological laboratory of the University of Illinois, No. 84.

824. **Taylor, Mary K.** Ethical opportunities in teaching English. English leaflet, 18:1–8, March 1917.

825. **Trams, A. Francis.** A pedagogue's plaint. School and society, 5:467–69, April 21, 1917.

Advocates dropping the classics in high school English teaching because they are beyond the high school pupil, and substituting good magazines and newspapers.

826. **Wallin, A. R.** Latin of tomorrow. Classical journal, 12:535–45, May 1917.

The study of Latin produces habits of logical thinking and accuracy of expression.

827. **Wells, H. G.** The case against the classical languages. Fortnightly review, 101: 567–74, April 1917.

Reviews the work by R. W. Livingstone, "A defense of classical education." Attacks the exclusive predominance of classical education.

828. **Wilkins, Lawrence A.** How shall we improve the study of Spanish? Bulletin of the High school teachers' association of New York city, no. 65: 3–12, April 1917.

829. **Wilson, Emma J.** Shall we abolish grammar? English journal, 6: 308–313, May 1917.

KINDERGARTEN AND PRIMARY SCHOOL.

830. **Davidson, Percy E.** The prospect for the scientific study of kindergarten education. Kindergarten and first grade, 2: 189–94, May 1917.

Read before the Kindergarten section of the California teachers' association, San Francisco.

831. **Farrar, Margaret.** Some difficulties of the public school kindergartner. Kindergarten and first grade, 2: 197–99, May 1917.

Paper read before the Northern Illinois teachers' association.

832. **Stuart, Josephine B.** Language in the primary grades. New Bedford, Mass., E. Anthony & sons, inc., printers, 1917. 183 p. 12°.

RURAL EDUCATION.

833. **Conference on rural education, State normal school,** Worcester, Mass., March 1917. [Papers.] Education, 37: 541–89, May 1917.

Contains: 1. W. B. Aspinwall: The new conception of the rural school problem, p. 541–44. 2. Payson Smith: A rational program for rural education, p. 545–47. 3. W. D. Hurd: How the curriculum may better meet present day social needs, p. 548–56. 4. Ella M. Clark: Vitalizing school studies. The situation in one Massachusetts town, p. 557–62. 5. A. S. Woodward: Vitalizing a rural school course, p. 563–68. 6. J. C. Muerman: The revitalized course of study, p. 569–71. 7. Grace C. Smith: Vitalizing rural school work in Massachusetts, p. 572–76. 8. M. Harriet Bishop: An example of a "vitalized" school, p. 577–78. 9. J. D. Eggleston: First aid to the citizen-makers, p. 579–89.

834. **Aspinwall, William B.** The new conception of the rural school problem. Education, 37: 541–44, 1917.

The curriculum should be directed towards the ultimate promotion of community betterment.

835. **Brown, C. J.** Rural school development in the South. High school quarterly, 5: 170–77, April 1917.

The writer discusses particularly Louisiana and says that the history of rural school development in Louisiana is typical of what has been happening all over the South.

836. **California. State board of education.** The landscape improvement of rural school grounds. Written by Professor J. W. Gregg. Sacramento, California state printing office, 1917. 52 p. illus., diags. 12°. (California state board of education. Bulletin, no. 20.)

837. **Smith, Payson.** A rational program for rural education. Education, 37: 545–47, May 1917.

SECONDARY EDUCATION.

838. **Bailey, W. A.** The administration of quantitative and qualitative credit for high school work. School review, 25: 305–21, May 1917.

Concludes that the principle is sound under certain conditions, which the writer sets forth. Says that curricula, subjects, and methods "must be more fully standardized before the system of quantitative and qualitative credit can mean the same thing in different schools." Results of a study made in the Kansas City high school, Kans.

839. **Bragdon, C. S.** Are there defects in the content of the high school curriculum? Journal of the New York state teachers' association, 4: 127–32, May 1917.

The defects in the present curriculum and the characteristics of the high school of the future.

840. **Hines, H. C.** The present status of the junior high school. Educator-journal, 17: 462–65, May 1917.

841. **Mackie, Ransome A.** G. Stanley Hall on adolescent education. American school, 3: 104–6, April 1917.

"A marshalling of G. Stanley Hall's dicta on adolescence in its relation to high school policies, courses of study, and methods."

842. **Rapeer, L. W.** A core curriculum for high schools. School and society, 5: 541–49, May 12, 1917.

Preliminary report for criticism of chairman of a committee of one hundred five of the High school department of the Pennsylvania education association.

Says the factors of social efficiency are vital efficiency, vocational efficiency, avocational efficiency, civic efficiency, and moral efficiency. Gives the principles underlying the high-school's program of studies and proposed programs of study with a core curriculum required of all pupils.

843. **Sakamoto, K.** The middle schools in Japan. Educational review, 53: 490–96, May 1917.

844. **Smith, M. L.** The little school with a big ambition. Kansas teacher, 5: 5–7, May 1917.

Tells how the Kincaid high school, Kincaid, Kans., has found its place in the community.

TEACHERS: TRAINING AND PROFESSIONAL STATUS.

845. **Andrews, William E.** Training teachers in the small public high school by cooperative study of daily work. School and home education, 36: 247–50, May 1917.

Training in service for high school teachers who are recent college graduates without professional training.

846. **Finegan, Thomas E.** Some of New York's contributions to the development and standardization of state normal schools. [Oswego, N. Y., Printing department, State normal and training school, 191–?] 18 p. illus. 8°.

Address at the dedication of the new building for the State normal and training school at Oswego, July 1, 1914.

847. **New York (State) University.** Teacher training agencies. A historical review of the various agencies of the state of New York employed in training and preparing teachers for the public schools of the state, by Thomas E. Finegan, deputy commissioner of education and assistant commissioner for elementary education . . . Albany, The University of the state of New York, 1917. 439 p. plates. 12°.

Volume 2 of the eleventh annual report of the State department of education.

848. **Smith, Walter R.** Proper function and limitations of normal schools. Educational review, 53: 465–82, May 1917.

Discusses the findings of the survey of the state higher educational institutions of Iowa, recently published by the U. S. Bureau of education.

849. **Stoutemyer, J. H.** The educational qualifications and tenure of the teaching population. School review, 25: 336–45, May 1917.

Second and concluding paper. Says that the data on the educational qualifications of the teaching population show a serious lack of academic and professional training. In general 60 per cent or more of the teachers have not completed a normal or college course.

HIGHER EDUCATION.

850. **Association of American colleges.** The efficient college . . . Chicago, Ill., Association of American colleges, 1917. 58 p. 8°. (Association of American colleges bulletin, vol. 3, no. 2, March 1917.)

Contains Prof. E. A. Miller's review of previous report, Dr. Calvin H. French's oral presentation of his report, The efficient college (revised edition) by Dr. French, and Review by committee.

851. **Association of collegiate alumnae.** Papers read at the thirty-fourth general meeting, Washington, D. C., April 10–14, 1917. Journal of the Association of collegiate alumnae, 10: 579–663, May 1917.

Contains: 1. M. Carey Thomas: The curriculum of the woman's college, p. 585–91. 2. Mary E. Woolley: The college curriculum as a preparation for life, p. 591–94. 3. Ada L. Comstock: Address on the college curriculum as a matter of teaching, p. 595–99. 4. Ruth O'Brien: The college woman and her country's need, p. 607–10.

852. **Beard, J. Howard.** College health services: their purpose and activities. Journal of sociologic medicine, 18: 173–90, June 1917.

Results of an inquiry into the organization and activities of the health services of the leading colleges of the United States and Canada.

853. **Boucke, O. F.** Lecture or recitation in colleges. Educational review, 53: 497–503, May 1917.

854. **Capen, S. P.** The report of the survey of the University of Nevada made by the United States Bureau of education. School and society, 5: 500–506, April 28, 1917.

855. **Chancellor, William E.** College professors and the N. E. A. Journal of education, 85: 481–83, May 3, 1917.

"The purpose of this paper is to explain why college professors not engaged in teaching education are indifferent to the National education association."

856. **Collins, V. L.** Twelve years of the preceptorial method of instruction. Princeton alumni weekly, 17: 645–48, April 18, 1917.

The preceptorial aims, some results of the method, the successful preceptor, etc.

857. **Kunkel, B. W.** Standing of undergraduates and alumni. School and society, 5: 549–55, May 13, 1917.

An investigation carried on among the graduates of Lafayette college to determine the relation between standing in college and success in later life.

858. **Rolfe, John C.** The aim and method of a college teacher of the classics. Alumni register, University of Pennsylvania, 19: 556–64, May 1917.

Read at the Classical conference, Schoolman's week, April 12, 1917.

859. **Stearns, Wallace N.** The place and scope of the small college. American schoolmaster, 10: 145–57, April 1917.

SCHOOL ADMINISTRATION.

860. **Deffenbaugh, W. S.** Effective and economical supervision in the smaller cities. American school, 3: 107–9, April 1917.

Paper read at the round table of cities less than 25,000 population, Department of superintendence, N. E. A.

861. **Eckels, J. H.** Efficient supervision. School news, 6: 3–5, May 1917.

Paper read before Conference of supervising principals of seven central counties of New Jersey.

Efficiency of school administration and supervision, as measured by results shown in persistency of pupils and per cent of promotions.

862. **Gros, J.** La direction chargée de classe. Revue pédagogique, 70: 64–80, January 1917.

Shows the necessity of having a director or principal in a school free from teaching duties.

863. **More, Louis T.** If I were a school superintendent. Nation, 104:534–37, May 3, 1917.

A criticism of some features of modern public-school education.

864. **Raper, Charles Lee.** The steps the Southern states must take to provide a just and ample revenue. High school quarterly, 5:162–70, April 1917.

865. The relations between boards of education and superintendents. An important report of the Department of superintendence of the National education association. American school board journal, 54:23–24, 81, May 1917.

Also in School and society, 5:471–74, April 21, 1917.

866. Shall the municipality buy for the schools? American school board journal, 54:25–26, May 1917.

Opinions from leading educators.

867. **Straubenmuller, Gustave.** Supervision. Bulletin of the High school teachers' association of New York city, no. 66:3–10, May 1917.

An address delivered before the supervisors of the high schools of the city of New York, February 6, 1917.

868. **Wirt, William.** Progress in education through school administration. American education, 20:524–29, May 1917.

SCHOOL MANAGEMENT.

869. **Cole, Thomas R.** One year of supervised study. Shcool review, 25:331–35, May 1917.

Results of a plan in the Broadway high school, Seattle, Wash.

870. **Edwards, A. S.** Directing study in the schoolroom. High school quarterly, 5:158–61, April 1917.

Gives some general suggestions for study.

871. **Mertz, L.** Essai de catéchisme pédagogique: comment lutter contre l'indiscipline. Revue universitaire, 26:248–55, April 1917.

Directions, especially intended for young teachers, on the management of a class.

872. **Watts, Rowland.** An investigation of the causes of failure of pupils in Baltimore public schools. Atlantic educational journal, 12:483–89, May 1917.

An investigation of pupils of the sixth, seventh, and eighth grades in Baltimore public summer schools, showing the failures in different subjects and the methods of study. The results show the need for devoting more time to supervised study.

873. **Wilson, H. B.** Training pupils to study. Atlantic educational journal, 12:419–27, 475–81, April, May 1917.

The first section is an analytical presentation in outline form of the results obtained from grade to grade in the different subjects in training the children in right habits of study; the second section presents a few complete reports showing what different teachers did in detail in training the children to study.

SCHOOL ARCHITECTURE.

874. **Leather, Fitzherbert.** The one-story schoolhouse idea with plans of model schools. Chicago. Ill., Pub. by the Trade extension department, The National lumber manufacturers' association, 1917. 56 p. illus. 8°. (Educational series no. 2, General series no. 49, February 1917.)

Prepared in cooperation with the U. S. Bureau of education.

875. **Pittsburgh architectural club.** School houses. The eleventh annual year-book of the Pittsburgh architectural club. [Pittsburgh, 1916] cover-title, 136 p. col. front., plates, plans. 4°.

PHYSICAL TRAINING.

876. **LaRue, J. D.** Effect of athletics on high school scholarship. American schoolmaster, 10: 166–69, April 1917.

The statistics presented support the argument that athletics, when properly handled, do not in any sense interfere with the studies of the pupil, but rather show a tendency to better his work while engaged in them.

877. **Meylan, George L.** Standards and measurements of proficiency in physical education. American physical education review, 22: 211–14, April 1917.

Tests and standards established at Columbia university in the physical education course.

878. **Monilaw, William J.** The effects of training down in weight on the growing boy and how to control or abolish the practice. School review, 25: 350–60, May 1917.

Says that we must encourage the ideal of play and recreation, and not place so much emphasis upon championships.

879. **Rockwell, Ethel.** Athletics for elementary school girls. Playground, 11: 94–102, May 1917.

880. **Stecher, William A.** After-school physical education activities. Mind and body, 113–18, May 1917.

Read at the meeting of the American physical education association, Pittsburgh, Pa., April 1917.

881. **Zinman, Meyer E.** The need for a new ideal in physical training. American education, 20: 540–42, May 1917.

The writer says that vitality, not muscular development, is needed for our city boys and girls, and that there must be an entire change in the method of conducting the gymnasium period.

PLAY AND PLAYGROUNDS.

882. **Bureau of educational experiments, New York.** Committee on toys and school equipment. Playthings. New York, Bureau of educational experiments, 1917. [15] p. illus. 8°. (Bureau of educational experiments, Bulletin no. 1.)

883. **Stitt, Edward W.** Practical problems of administration in school playgrounds. American school board journal, 54: 20–21, 81, May 1917.

SOCIAL ASPECTS OF EDUCATION.

884. **Armstrong, Donald B.,** *and* **Berkowitz, J. H.** An urban community plan for health and medical service. Reprinted from the Modern hospital, vol. 8, no. 5, May 1917. 3 p. 4°.

Suggests the provision of medical and health service on a community basis in cooperation with school groups.

885. **Church, Clarence C.** The schools and leisure occupation. American schoolmaster, 10: 145–57, April 1917.

Outlines "some of the ways by which the teacher, the course of study, and the school have affected and can influence the leisure occupations of the people."

886. **Smith, Walter Robinson.** An introduction to educational sociology. Boston, New York [etc.] Houghton Mifflin company [1917] xvii, 412 p. 12°. (Riverside textbooks in education, ed. by E. P. Cubberley.

MORAL EDUCATION.

887. **Perry, A. C.,** *jr.* The teacher as a moral course. Educational review, 53: 459–64, May 1917.

Says that the chief factor in the problem of moral training is to improve the technique of the practical classroom teachers.

RELIGIOUS EDUCATION.

888. **Athearn, Walter S.** A community system of religious education. Boston, Mass., The Pilgrim press, 1917. 45 p. 12°. (Malden leaflets, no. 3.)

889. ———. Sex segregation in religious education. 16 p. 16°.

Reprinted from the Graded Sunday school magazine.

890. **Lott, Henry C.** Bible courses in higher educational institutions. American schoolmaster, 10: 105–13, March 1917.

MANUAL AND VOCATIONAL TRAINING.

891. **Babbitt, Arthur B.** The present status of mechanical drawing and its future in the schools. Industrial-arts magazine, 6: 233–36, June 1917.

Read before the Boston manual training club, Boston, Mass., February 10, 1917.

892. **Bain, Francis L.** Co-operative industrial education in Boston, Mass. Manual training magazine, 18: 365–70, May 1917. illus.

893. **Chancellor, William Estabrook.** Vocational sociology. Industrial-arts magazine, 6: 223–27, June 1917.

894. **Hamilton, W. I.** The place of the prevocational. School and society, 5: 515–20, May 5, 1917.

895. **Quénioux, Gaston.** Les cours professionnels de l' "Umanitaria." Revue pédagogique, 70: 56–63, January 1917.

A description of vocational schools in Milan.

896. **Snedden, David.** The illusions of "prevocational" education. School and society, 5: 511–15, May 5, 1917.

Based on portions of an address delivered before the National society for the promotion of industrial education, Indianapolis, February 23, 1917.

VOCATIONAL GUIDANCE.

897. **Hoopes, Helen R.** Vocational guidance for women. Graduate magazine of the University of Kansas, 15: 195–200, April 1917.

Discusses the various bureaus of occupations for women.

AGRICULTURAL EDUCATION, SCHOOL GARDENS.

898. **Claxton, P. P.** School gardening in the food crisis. American review of reviews, 55: 517–18, May 1917.

Presents many interesting statistics.

899. **Dewey, John.** Enlistment for the farm. New York, Division of intelligence and publicity of Columbia university, 1917. 10 p. 12°. (Columbia war papers, series 1, no. 1)

A message to the school boards, principals, and teachers of the nation on how school children can increase the food supply of the country in war time and during a world-wide shortage of food.

900. **Feasey, J. Eaton.** The educational use of school gardens. Contemporary review, 111: 514–20, April 1917.

Discusses the educational advantages of school garden work, leading to arithmetic, geography, botany, nature study, drawing and elementary science.

901. **Highfill, LeRoy.** Agricultural education—some notes on its development. Florida schoolroom, 23: 3–8, April 1917.

Read at the Pinellas county association, Tarpon Springs, April 7, 1917.

902. **Lane, Winthrop D.** A farm census in five days: Educational values of a war time service for school children. Survey, 38: 155–56, May 19, 1917.

A plan put into effect in New York state, in April 1917. The commission, appointed by Governor Whitman, used the teachers and the school children for the task of surveying the agricultural resources of the state, etc.

HOME ECONOMICS.

903. **Calvin, Henrietta W.** Some administrative problems in home economics in the public schools. Journal of home economics, 9:199–204, May 1917.

Presented at the meeting of the American home economics association, Kansas City, March 2, 1917.

904. **Heyle, Essie Margaret.** The school lunch as a project in teaching cookery in the elementary schools. Journal of home economics, 9:205–10, May 1917.

905. **Randall, Leaffa.** Co-operation of home economics teachers with other teachers. Arkansas teacher, 5:2–5, May 1917.

906. **Tryon, Rolla Milton.** Household manufactures in the United States 1640–1860; a study in industrial history. Chicago, Ill., The University of Chicago press [1917] 413 p. 12°.

Contains material to meet the present-day demand for industrial history material in schools and colleges.

PROFESSIONAL EDUCATION.

907. **American medical association. Council on health and public instruction.** Conference on public health instruction in medical colleges and state regulation of the practice of medicine, Chicago, February 6, 1917. 267–314 p. 8°. (American medical association bulletin, vol. 12, no. 4, March 15, 1917. Public health number) (F. R. Green, secretary, 535 North Dearborn street, Chicago, Ill.)

Contains 1. G. E. Vincent: Public health training in universities, p. 273–80. 2. M. J. Rosenau: Public health instruction in medical schools, p. 281–93; Discussion, p. 293–300.

908. **American medical association. Council on medical education.** Report of the thirteenth annual conference, Chicago, February 5, 1917. 191–266 p. 8°. (American medical association bulletin, vol. 12, no. 4, March 15, 1917. Educational number) (N. P. Colwell, secretary, 535 North Dearborn street, Chicago, Ill.)

Contains: 1. N. P. Colwell: Progress of the year in medical education, p. 196–206. 2. H. D. Arnold: The problem of higher degrees in medicine, p. 207–10. 3. A. D. Bevan: [Economy of time in preliminary and medical education] Address of the chairman, p. 212–19. 4. P. P. Claxton: Economy of time in preliminary and medical education, p. 219–25. 5. H. P. Judson: Economy of time in preliminary and medical education, p. 225–32; Discussion, p. 232–35.

909. **Burling, Lancaster D.** Education, efficiency and economy, with special reference to mining. Scientific monthly, 4:438–45, May 1917.

910. **Higbie, H. H.** What is best in engineering education? Engineering education, 7:491–504, April 1917.

911. **Plew, W. R.** The professional school in higher education. Inter-mountain educator, 12:3–7, April 1917.

Read before the Montana state teachers' association.

CIVIC EDUCATION.

912. **Berkey, J. M.** Americanization a civic responsibility. Journal of the New York state teachers' association, 4:121–27, May 1917.

913. **Gruenberg, Benjamin C.** What are the opportunities before the high schools of the country in training men for public service and for efficient citizenship? School and society, 5:577–82, May 19, 1917.

From an address at the third National conference on universities and public service, University of Pennsylvania, November 16, 1916.

914. **Johnston, Charles Hughes.** The high school and modern citizenship. Educational administration and supervision, 3: 189–206, April 1917.

Social studies in the high school.

915. **Lodge, Gonzalez.** The value of the classics in training for citizenship. Teachers college record, 18: 111–21, March 1917.

An address delivered before the staff of Teachers college, February 8, 1917.

916. **Skinner, E. Mabel.** Training for citizenship. Journal of education, 85: 437–39, April 19, 1917.

Helpful means of training our boys and girls in community civics.

MILITARY EDUCATION.

917. **Averill, Lawrence Augustus.** What of military training in our schools? American journal of school hygiene, 1: 69–73, April 1917.

Does not approve of military training in the schools but recommends universal and systematic health work throughout the entire school life of the child.

918. **Burgess, W. R., Cummings, H. B.,** *and* **Tomlinson, W. P.** Military training in the public school. An annotated bibliography. Teachers college record, 18: 141–60, March 1917.

919. **Hughes, Sam.** The argument for a national system of military training in the schools. Outlook, 116: 20, May 2, 1917.

EDUCATION OF WOMEN.

920. **Banker, Howard J.** Coeducation and eugenics. Journal of heredity, 8: 208–14, May 1917.

Women graduates of Syracuse university have very low marriage and birth rates—those of men graduates are much higher—colleges perhaps receive an abnormal type of woman and nature of education can effect little change in her unmarriageable character.

921. **Haight, Elizabeth Hazelton.** James Monroe Taylor: his service for the education of women. Journal of the Association of collegiate alumnae, 10: 511–16, April 1917.

NEGRO EDUCATION.

922. **Willcox, William G.** Tuskegee's future. Southern workman, 46: 268–72. May 1917.

Address at celebration of Founder's day, Tuskegee, April 5, 1917.

EXCEPTIONAL CHILDREN.

923. **Wallin, J. E. Wallace.** The feebleminded in the state of Missouri. Psychological clinic, 11: 55–62, April 15, 1917.

Delivered before the Missouri conference for social welfare, Columbia, November 1916.

The inadequate provision for feeble-minded children in Missouri and the remedy recommended by the Children's code commission.

EDUCATION EXTENSION.

924. **Emerson, Philip.** The lecture plan in elementary evening school work. Journal of education, 85: 458–60, April 26, 1917.

An account of the plan worked out in Lynn, Mass., for supplying fifth to eighth grade work in the evening school.

925. **Harvey, L. D.** The continuation school. Wisconsin journal of education, 49: 95–97, April 1917.

Wisconsin's experience in the development of continuation schools.

LIBRARIES AND READING.

926. **Miles, Dudley.** Socializing outside reading. English journal, 6: 330–33, May 1917.

Says that books reported on in class arouse genuine inquiries out of class hours.

927. **Powell, Sophy H.** The children's library; a dynamic factor in education. White Plains, N. Y., and New York city, The H. W. Wilson company, 1917. xiv, 460 p. 12°.

A careful study of the relations of children's reading to teachers, parents, and librarians. It discusses the place of reading in education, the history of books and libraries for children and of the library in the elementary school; and goes on to the high school, to the library itself, to the latter's place in education, and to the special activities of the library toward children.

BUREAU OF EDUCATION: RECENT PUBLICATIONS.

928. Suggestions for the conduct of educational institutions during the continuance of the war, to the end that their educational efficiency may not be lowered, and that they may render the largest amount of service both for the present and for the future; by the Commissioner of education. Washington, 1917. 8 p.

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DEPARTMENT OF THE INTERIOR
BUREAU OF EDUCATION

BULLETIN, 1917, No. 29

PRACTICE TEACHING FOR TEACHERS IN SECONDARY SCHOOLS

WASHINGTON
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LETTER OF TRANSMITTAL.

Department of the Interior,
Bureau of Education,
Washington, June 1, 1917.

Sir: Despite the fact that normal schools which prepare teachers for elementary schools learned long ago that "a normal school without a practice school is like a swimming school without water," and that no effective professional training can be given without ample opportunity for observation of the ordinary processes of teaching and school organization and management, and for practice in teaching under expert direction and intelligent sympathetic criticism, few college and university classes, schools, and departments of education for the preparation of teachers for high schools and of superintendents, supervisors, principals, and special teachers made at first any provision for such observation and practice. Their experience has, however, finally taught them that high-school teachers, superintendents, supervisors, principals, and teachers of special subjects need opportunity for observation and practice during the period of their professional preparation no less than do those who are preparing to teach in the elementary schools, and, one after another, colleges and universities with classes, schools, or departments of education have established some kind of practice or observation school for the use of their students or have made other arrangements for them to do work of this kind. That information in regard to the organization, maintenance, and use of these schools and in regard to results obtained so far may be available, I recommend that the manuscript transmitted herewith on practice teaching for teachers in secondary schools be published as a bulletin of the Bureau of Education. This manuscript was prepared by Mr. A. R. Mead, of Ohio Wesleyan University, as a result of an extensive study of this subject, and has been revised for the use of this bureau at my request.

Respectfully submitted.

P. P. Claxton, *Commissioner.*

The Secretary of the Interior.

PRACTICE TEACHING FOR SECONDARY SCHOOL TEACHERS.[1]

REPORT OF A STUDY OF INSTITUTIONS WITH TEACHER-TRAINING DEPARTMENTS.

By A. R. MEAD.

During the year 1914–15, a questionnaire was sent to all heads of departments of education and deans of schools and colleges of education listed in the directory of the United States Bureau of Education. The questions asked were as follows:

1. For practice teaching for prospective secondary teachers, do you use your own high school, or a public high school not under your control?
2. How many prospective secondary teachers actually do practice teaching?
3. How much teaching does each person do?
4. How are these persons selected?
5. Who actually supervises the practice teaching?
6. If you utilize a public high school, what does the privilege cost, and upon what is the cost based?
7. How do you administer practice teaching when the subject concerned is a laboratory science?
8. Please give any suggestions you desire regarding what you consider the best general organization and administration of this type of professional training.

The classification of the returns was made upon about the same basis as that used by Prof. C. H. Johnston for the Society of College Teachers of Education (see Year Book for 1914, p. 8). In the State university group, 30 replies were received; from the second group, large non-State universities, 13 replies were received, if Cornell be included; from the third group there were 133 replies; and from the State agricultural colleges there were 6. This makes the total of replies 182. In addition, a few letters from individuals not representing any institution were received. The total number of institutions to which questionnaires were sent was 295. Slightly less than 65 per cent of the institutions replied.

Of the first group, the following institutions made no provision for student teaching for prospective secondary teachers: Alabama, Illinois, Kentucky, Michigan, Mississippi, New Mexico, South Dakota, Tennessee, Vermont, Virginia; total, 10, or 33⅓ per cent of the State universities. Of this group which do not make such provisions, the following are planning to establish such work: Illinois, Kentucky, Tennessee, Vermont, Virginia. It is probable that others are planning such work, but their replies do not reveal the fact. Then it appears that 66.6 per cent of the State universities reporting are actually giving this work, and 83.3 per cent are either giving or planning to give it.

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[1] Much of the material in this bulletin was gathered by the committee on practice teaching of the Society of College Teachers of Education. The studies of Mead, Chambers, Childs, and Gray are from reports of this committee; likewise most of the descriptions of systems utilized by different institutions. The bibliography was compiled by Dr. Romiett Stevens and the chairman of the committee.

STATE UNIVERSITIES.

Student teaching for prospective secondary teachers.

Universities.	Secondary school used.		Number of prospective teachers.	Amount of teaching done (semester hours).
	Own.[1]	Public.[1]		
Arkansas	×		[2] 50	10
California	×		30–40	5
Georgia		×	10–15	[3] 1
Idaho		×	[2] 10	1–5
Iowa		×	[2] 20	2–3
Kansas	×	×	75	2.5–5
Maine		×	2–6	5
Minnesota	×		100	5
Missouri	×		60	10
Montana		×	10	(3)
Nevada		×	10–20	10
North Dakota	×		20	(4)
Ohio State		×	30	5
Oregon		×	61	5
Texas		×	36	1⅓–2¾
Utah	×		30	4
Washington		×	40	[2] 8
West Virginia		×	10–15	¼–½
Wyoming	×		(5)	5
Total	8	11	614–648	80 1/12–89¼
Average			32–34	4 1/5–4 11/16
Median			30	5
Average deviation			22	2.2

[1] The cross (×) means yes.
[2] Approximately.
[3] Includes observation.
[4] Given as "Two months' observation and two months' practice."
[5] Required of "all who take course in senior year."

HOW THE STUDENT TEACHER IS SELECTED AT STATE UNIVERSITIES.

Arkansas.—Persons who major in school of education teach the subject they desire to specialize in.

California.—Furnish teaching for all "cadets."

Georgia.—Persons detailed from class.

Idaho.—Seniors given first choice; those with most preparation given preference.

Iowa.—Seniors in university. Selected by methods teachers.

Kansas.—Seniors or graduates who are candidates for State teacher's certificates. Usually have a special methods course.

Maine.—One semester of education is a prerequisite. Recommended by major instructor and approved by dean of department of education.

Minnesota.—On basis of university major.

Missouri.—By the superintendent of the university schools.

Montana.—Preliminary work in education and in major subject as basis.

Nevada.—Those taking "Education 3, Theory and Practice."

North Dakota.—Seniors in school of education.

Ohio State.—Required of all seniors in college of education.

Oregon.—Dean of school of education, head of collegiate department, and principal of high school cooperate to make selection.

Texas.—Required of all who desire the teacher's diploma.

Utah.—Seniors meeting requirements for high-school diploma.

Washington.—Students elect work subject to approval of instructor in charge.

West Virginia.—Any person qualified to take education course.

Wyoming.—Required of seniors in department of education.

BY WHOM TEACHING IS SUPERVISED.

Arkansas.—Supervisor of training and critic teachers.

California.—Two experienced men teachers; heads of departments less frequently.

Georgia.—Teacher in charge.

Idaho.—High-school principal and department of education. In some cases collegiate department exercises minor supervision.

Iowa.—Special methods teacher is head of department in high school and supervises the work. Some supervision by general methods teacher.

Kansas.—Principal of school who is also assistant professor of education. Representative of the collegiate department.

Maine.—Principal of high school and professor of education.

Minnesota.—Special supervisor.

Missouri.—Superintendent of university school and representative of collegiate department concerned and some special supervisors.

Montana.—Five critic teachers, members of faculty of Missoula County high school, with professor of education.

Nevada.—Instructor who gives theory and practice.

North Dakota.—Superintendent with general supervision and regular teachers with specific management.

Ohio State.—Professor of principles and practice.

Oregon.—Department of education.

Texas.—Professor of art or teaching and his assistants.

Utah.—Training school department supervisor and representative of the department of education.

Washington.—One member of department of education and regular teacher.

West Virginia.—Department of education.

Wyoming.—Professor of secondary education has general charge. Special supervision given by teacher of branch in high school.

COST OF USE OF PUBLIC HIGH SCHOOL.

Iowa.—Each teacher observed in paid $10 per month. The supervising teacher of practice teaching is paid one-half of salary by the university and one-half by local school board.

Montana.—The critic teachers, members of high-school staff, receive $40 each.

Nevada.—Allow student teacher to act as substitute teacher in high school, in case of sickness, for one week.

HOW WORK WAS ADMINISTERED WHEN SUBJECT WAS A LABORATORY SCIENCE.

The replies were too indefinite to be of much value. They seem to indcate that actual laboratory work is done by the student teacher.

SUGGESTIONS AS TO ORGANIZATION AND ADMINISTRATION.

1. Model or practice school should be a part of the school of education.

2. Greatest need for typical high-school experience in a real public high school. A separate school under university control should be established only when the other can not be secured, and even then it should not pose as a model school.

3. To use own high school gives satisfaction.

4. First, student in senior year should have observation in the second semester. Second, this should be followed by one more semester of work composed entirely of teaching in a real high school. Supervision under experts from education department.

5. Student teaching in eighth grade is better than teaching but one subject in a high school for practice work.

6. "I believe the only successful plan is to have a school for observation and practice under the complete control of the school of education. Then you can command and get things done without begging and compromising with other powers."

7. Make use of the seventh and eighth grades and high school for the work, remove the weak candidates and do not allow them to teach, and give student teacher full power and control over class.

8. Use school under your own control and supplement it with work in a public high school.

9. Favor supervision by department supervisor and college department of education.

10. Should have own practice school, the teachers of which you could select and you should have entire management of it.

These show that five, or one-half, prefer to have a high school controlled by the university, college, or school or department of education. Other suggestions are so scattered that they show no agreement.

NONSTATE UNIVERSITIES.

Student teaching for prospective secondary teachers.

Universities.	Secondary school used.		Number of prospective teachers.	Amount of teaching done (semester hours).
	Own.[1]	Public.[1]		
Chicago	×	(2)	75	[3] 1-2
Cincinnati		×	(4)	
Cornell		×	(5)	
George Washington	×		5	[6] 2
Harvard		×	40	2½-6⅔
Johns Hopkins			(7)	
New York		×	(8)	
Northwestern	×		15	5
Pennsylvania		×	(8)	
Pittsburgh		×	(4)	20
Leland Stanford		×	30	[9] 5
Teachers' College		×	100	(10)
Washington (St. Louis)		×	25	1⅓
Total	2	11	290	32.1-38.6
Average			41	4-4.8
Median			30	4.55
Average deviation			27	

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[1] The cross (×) means yes.
[2] Uses classes in private schools and in social settlements, as well as own high school.
[3] Maximum of about seven semester hours required of candidates for degree.
[4] All who complete course.
[5] Work very limited.
[6] Uses eighth grade for most of work.
[7] No practice teaching.
[8] Work now being organized.
[9] Use also assistantships in university.
[10] Depends upon previous experience.

HOW THE STUDENT TEACHER IS SELECTED AT NON-STATE UNIVERSITIES.

Northwestern.—By heads of collegiate departments concerned.

New York University.—Selected by dean.

Pennsylvania.—All seniors in school of education required to do this teaching.

Pittsburgh.—All persons who complete course in school of education.

Teachers College.—Matter settled very largely by the student's faculty adviser.

Harvard.—Certain senior and graduate students.

Cincinnati.—Selected by professor of secondary education.

Leland Stanford.—Elective for graduate students.

Chicago.—Required of all college of education students, and elective for arts and science students.

Washington (St. Louis).—"Fitness for certain subjects."

George Washington.—All without successful teaching experience.

WHO ACTUALLY SUPERVISES THE PRACTICE TEACHING.

Northwestern.—Critic teachers and professor of secondary education.

New York University.—One of the instructors of the school of pedagogy.

University of Pennsylvania.—The professor and assistant professor of educational practice.

Pittsburgh.—"Our own supervisor, the principal of high school."

Teachers College.—"Instructor of methods classes and heads of departments in schools."

Harvard.—Professor of secondary education has general charge. "The teacher of the department in the high school; the principal."

Cincinnati.—Professor of secondary education and the regular teacher of the class where the teaching is done.

Leland Stanford.—Member of the department of education has general charge. Is assisted by school principals, and professors of collegiate departments who permit practice teaching in their classes.

Chicago.—Regular room teacher and some members of the collegiate department concerned in the college of education, e. g., department of history.

Washington (St. Louis).—The regular teacher of the room and the professor of education.

George Washington.—Professor of education and the regular teacher of the room.

In seven of these cases the real supervision is conducted by a combination—a member of the staff of the department or school of education and a member of the staff of the school where the teaching is done. In but one institution, Leland Stanford, is it evident from the returns that a member of the staff of the liberal arts faculty helps in the supervision, and in this case it is probably only with such instances as teaching done by student teachers in college classes. Outside of these two generalizations, it seems to be evident that wide variation exists.

THE COST OF THE USE OF THE PUBLIC HIGH SCHOOL.

At Pittsburgh the school granting the privilege of student teaching is given a scholarship for two hours' work in the classes in education. On the other hand, the board of education pays the necessary expenses of the student teacher. At Teachers College the student teacher may receive remuneration for the service, but it is not apparent that the college makes any money payment for the service. This is true because the work is largely that of substitute teachers in the city schools. At Harvard, "in return for each position occupied by one of our students, we grant a single course free of tuition to any teacher named by the superintendent of the town." In the following institutions the privilege of student teaching in the public high school is given at no expense to the school or department of education: George Washington, Washington (St. Louis), Leland Stanford, Cincinnati, Pennsylvania, New York University; total, six. Others do not use a high school, or do not report anything under this item.

ADMINISTRATION OF STUDENT TEACHING FOR LABORATORY SCIENCE.

At Northwestern the student teacher must take charge of laboratory periods as if the class were his own. At Pittsburgh the first year is often spent chiefly as a laboratory assistant, the second year is that of teaching, and the laboratory work is extra. At Teachers College the student teacher acts as assistant. This covers a period of nine weeks. At Harvard the student teacher actually directs the laboratory work. At the University of Cincinnati the student begins as assistant and later does actual teaching. At Leland Stanford some few do assistant work in freshman class of the college. At Chicago the teacher takes actual charge of the laboratory period. George Washington, Washington, New York University, and Pennsylvania report that they have as yet done nothing with this kind of work.

This reveals two dominant practices: First, acting as assistant in the laboratory; second, combining this with some real direction of laboratory work.

SUGGESTIONS AS TO ORGANIZATION AND ADMINISTRATION.

The reply from Cornell University recommends the New York City "teachers in training" plan. From Johns Hopkins comes the statement that the plan of using public high schools has certain advantages, if it can be established upon a cooperative basis. The following from Northwestern seems very good: (1) A practice school over which you have absolute control; (2) a good corps of critic teachers; (3) cooperation on the part of all the heads of the departments in the university. These three things are necessary. The Pittsburgh plan is liked very much at that institution. It has one defect, i. e., that the distance from the school of education to the high school is often too great to work to efficiency. Harvard University, with its system of cooperation between the university and public high schools, would add pay from the university to critic teachers in public schools for good supervision. At Cincinnati the fact that the college of teachers is a part of the city system eliminates many difficulties found in other plans. From Stanford comes the following statement: "The thing most needed is, in my opinion, a university and not a department machinery and interest." From the school of education, University of Chicago: "Separate observation courses have been abolished." Theory and practice courses have been broken up into theory courses and practice courses, in order to protect the practice from neglect. The opinion from Washington University and George Washington University is that the practice school should be under control of the institution giving the training.

Here, again, is variety of opinion. There seems to be no general agreement in these suggestions.

OTHER UNIVERSITIES AND COLLEGES.

Student teaching for prospective secondary teachers.

Names.	Secondary school used.		Number of prospective teachers.	Amount of teaching done (semester hours).
	Own.[1]	Public.[1]		
Alfred University		×	5-6	(3)
Alma College		×	4	3
Ashland College		×	[4] 12	1-2
Baldwin-Wallace College	×		13	1⅓
Bellevue College	×	[2] ×	6-12	5
Beloit College				(5)
Bowdoin College	×		6	(6)
Brown University		×	15	[7] 8-30
Central College	×		4-7	3
Clark College		×	8-10	½-1
Coe College	[8] ×		(9)	4-5
College of the City of New York	×		25	[10] 1
Colorado College		×	0	20
Cotner College		×	20	5-10
Dakota Wesleyan University	×		(11)	(12)
University of Denver		×	40	3
Doane College	×		16	[13] 4
Earlham College		×		(14)
Elon College	×		15-20	(15)
Fairmount College	×	×	8	[16] 8
Franklin College		×	4	(17)
Geneva College		×	4-5	(18)
Grand Island College	×		6-10	5
Greenville College (Ill.)	×		6	(19)
Grinnell College		×		
Gustavus Adolphus College	×		10-15	5
Hanover College	×		(20)	(21)
Hastings College	×		2-6	(22)
Heidelberg University		×	18-20	1½
Henry Kendall College	×			
Hiram College		×	4	(23)
Hope College	×	×	12-20	(24)
Howard University (col.)		×	(25)	9
Juniata College	×		12-15	(26)
Kalamazoo College	×		25	(23)
King College	×		5	(27)
Lawrence College		×		(28)
Lebanon Valley College		×		
Lehigh University		×	4	2
Lincoln Memorial University	×	[2] ×		
Macalster College	×		12	2
Middlebury College		×	16	(29)
Milton College	×		6	(30)
Milwaukee-Downer College		×	40-50	2-4
Missouri Valley College	×		13	(31)
Missouri Wesleyan College	×		6	(32)

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[1] The cross (×) means yes.
[2] Joint control of a single school.
[3] Ten weeks.
[4] Approximately.
[5] "About a month's work."
[6] "From one day to two months."
[7] "150 to 600 periods."
[8] Uses subfreshman class.
[9] 25 per cent of seniors.
[10] "About 20 hours."
[11] "Very few."
[12] Very little.
[13] Two replies received; one gave "30 hours or more."
[14] Very little; not more than half a dozen periods a student.
[15] Two hours per week.
[16] One year, 4 hours a week.
[17] "One hour a day."
[18] Only a few days.
[19] Three to five hours a week.
[20] About 50 per cent of prospective teachers.
[21] Two weeks to one year.
[22] One semester.
[23] Minimum, 15 hours.
[24] Six weeks.
[25] All seniors.
[26] Average 2 hours a week.
[27] About 6 hours a week.
[28] Four weeks.
[29] One class a day.
[30] Two weeks in two subjects.
[31] Half a year.
[32] One class one semester.

Students teaching for prospective secondary teachers—Continued.

Names.	Secondary school used.		Number of prospective teachers.	Amount of teaching done (semester hours).
	Own.	Public.		
Mount Union College	×		9	1½
Muskingum College	×	[1] ×		
Nebraska Wesleyan University	×		25	5
Oberlin College		[2] ×	8	1½
Ohio Northern University		×	10	2-3
Ohio Wesleyan University	×		22	1½
Ottawa University	×		10-16	
Otterbein University	×	×		1½
Park College	×		6	½-1
Ripon College		×	15-20	(3)
College of St. Elizabeth	×			(4)
St. Johns University (Minn.)	×		13	(5)
St. Olaf College	×		30	2
Shaw University	×			
Southwestern University (Tex.)	×		15	5
Susquehanna University	×		3	(6)
Swarthmore College		×	14	(7)
Tarkio College	×		8-10	3
Temple University	×		25-30	(8)
Texas Woman's College	×	×	2	(9)
Trinity College (N. C.)	×	×		
Upper Iowa University		×	7	2½
Whitman College		×	6-10	
College of William and Mary		×	30	2½
Yankton College	×		5-6	(10)
York College	×		5	(11)
Total	46	35	700-754	[12] 95.5-128.5
Average			12.3-13.2	[12] 3.08-4.1
Average deviation (57 institutions)			7.02	[12] 2.1
Median (53 institutions)			10	[12] 2.5

[1] Joint control of a single school.

[2] Utilizes summer session of local high school for the work.

[3] About one week.

[4] Practice, 50 hours.

[5] Five to ten hours a week.

[6] Eight to ten hours a week.

[7] Six to eight weeks of practice.

[8] Varying amounts.

[9] Three hours a week.

[10] Five hours a week.

[11] Four hours a week.

[12] For 31 institutions.

The semester hours here tabulated are obtained by two methods: First, the amount of teaching was sometimes stated in semester hours; second, in other cases it was estimated on the basis of the number of class periods actually taught, counting 18 such periods as one semester hour. In computing the average deviations, but one set of measures has been used, i. e., the one measure and the minimum, for example, the measures for Temple University are 25-30, and 25 was the only one used. In the totals for institutions using "Own" or "Public" high school, there are nine cases in which both kinds are used. Also, Beloit reports that the students of the methods class teach each other. A number of institutions, not in the table, report the same practice, but give no other data, and so are not here included.

Some of the institutions offer practice teaching, but not for secondary teachers. Berea College offers this work, but only for the training of country school teachers. Two institutions report that they do not deem it wise to offer such work. One writes:

> There are a number of normal schools in this State which teach methods and nothing else much, and I feel that it is the mission of this school to give something that can not be gotten there. I base my work on the assumption that there are certain things which everyone should know, whether he teaches or not. I build it around two or three subjects as centers; one of these is genetic psychology, another abnormal psychology, and another hygiene.

Another writes:

> The practice school is usually too artificial to be worth much. In my opinion the smaller colleges will do best without it.

Fifty-seven of these institutions offer practice teaching for secondary teachers amounting to two or three semester hours, about 700 students sharing in this kind of work. Fifty-eight of these institutions offer no such work for secondary teachers, yet send their graduates into high schools to teach. Approximately 50 per cent of the third group, then, recognize the value of this work to the extent of offering a low minimum of it, while the other 50 per cent do not offer it at all.

HOW THE STUDENT TEACHERS ARE SELECTED.

Alfred University.—"They are seniors who have shown teaching ability in the education work of the junior year. They must also have the indorsement of the college department" concerned.

Alma College.—"The head of the department of education and the superintendent of schools consider the qualifications of the candidate and the need of the school and select on that basis."

Ashland College.—"All persons who finish our normal course." "By the head of the department."

Baldwin-Wallace College.—"From junior and senior college classes. Very few juniors."

Bellevue College.—Required of all who receive college first-grade certificate for Nebraska.

Beloit College.—Membership in methods class gives privilege of teaching members of same class.

Bowdoin College.—"By the professor of education."

Brown University.—"Partly by myself" (professor of education), "partly by the superintendent of schools, and partly by the school committee."

Central College (Mo.).—All who meet State requirements for college graduates' State certificate. "These are seniors in the college. We allow the stronger ones to begin in the first semester. The less promising we reserve until we are sure they will graduate, and until they have fulfilled all the other requirements."

Clark College.—"Only students who gave promise of success. With a single exception, they were men of high standing both in their general college work and in pedagogy. We mean to have it regarded as a privilege."

Coe College.—"By the officer of the subfreshman class on scholarship."

College of the City of New York.—Student approved first by head of collegiate department concerned, and then by head of department of education.

Colorado College.—Students make application for the work. Reply did not state further methods, if any used.

Cotner University.—Selected by the head of the department of education.

Dakota Wesleyan University.—Work is elective.

University of Denver.—Selected by head of department of education.

Doane College.—Required of all seniors who are candidates for teachers' certificates.

Earlham College.—Some juniors and seniors selected by superintendent and high-school principal.

Elon College.—Selected from classes of third and fourth year students.

Fairmount College.—Selected by the department of education in consultation with the departments in which the teaching is to be done.

Franklin College (*Ind.*).—Recommended by department of education in college and selected by the city superintendent.

Geneva College.—Selected by head of department of education and psychology.

Grand Island College.—"By president, head of department of education, and head of department in which teaching is done, in conference."

Greenville College.—"On recommendation of heads of departments."

Grinnell College.—Membership in class on methods and sanction of superintendent of schools.

Gustavus Adolphus College.—Seniors who wish State certificate.

Hanover College.—"By the president."

Hastings College.—"Have been able so far to supply work for all desiring it."

Heidelberg University.—"By the professor of education."

Henry Kendall.—Use advanced students to assist in academy.

Hiram College.—"Seniors expecting to teach who have had prerequisite course."

Hope College.—Seniors who make average of 85 per cent in all other work.

Howard University (*colored*).—All seniors required to do practice teaching.

Juniata College—Required of all who elect course in high-school methods.

Kalamazoo College.—"Each member of class in pedagogy takes his turn in alphabetical order." Required of all in class.

King College.—"By the president."

Lawrence College.—Selected by head of department of education.

Lebanon Valley College.—No report on this point.

Lehigh University.—Apparently the work is elective.

Lincoln Memorial University.—No report on this point.

Macalester College.—Required of all who expect to teach.

Middlebury College.—"By the head of the department on the basis of pedagogical, academic, and personal qualifications."

Milton College.—Membership in class in pedagogy for some. Others as to special fitness.

Milwaukee-Downer College.—Required of all candidates for certificates or degree in home economics.

Missouri Valley College.—"All those who take the course teach."

Missouri Wesleyan College.—Those preparing for State certificate.

Mount Union College.—"From upper classmen who are endeavoring to meet the new school code and who have had preceding theory."

Muskingum College.—Report does not reveal procedure.

Nebraska Wesleyan University.—"All seniors who have had prerequisites."

Oberlin College.—"All members of the class in practice teaching." Limited to summer work in 1914.

Ohio Northern University.—Report does not reveal practice followed.

Ottawa University.—Excellence in content subject and in course in principles of secondary method.

Otterbein College.—Report does not reveal actual practice followed.

Park College.—By the professor of education.

Ripon College.—By professor of education.

College of St. Elizabeth.—Juniors and seniors who elect pedagogy courses.

St. Johns University.—On basis of at least two years' college work.

St. Olaf College.—Seniors who received sanction of department concerned with content subject and who are taking 15 semester hours in education.

Shaw University (*colored*).—Work too recent to report on in detail.

Southwestern University (*Tex.*).—Head of department of education, principal of secondary school, and president. Then names are submitted to entire faculty for ratification.

Susquehanna University.—"By the president."

Swarthmore College.—All who do this have had at least 15 semester hours of education.

Tarkio College.—Required of all who are candidates for State certificates.

Temple University.—"By heads of college departments."

Texas Woman's College.—Practice followed not revealed by answer.

Trinity College (*N. C.*).—Work too recent to report practice followed.

Upper Iowa University.—Elective for seniors.

Whitman College.—City superintendent selects from list submitted to him.

College of William and Mary.—Required of all applicants for teachers' diploma in last year of course. Assignments made by professor of education.

Yankton College.—Professor of normal work and heads of college departments.

York College.—By professor of education and regular teacher.

The following methods of selection occur frequently enough to make them noticeable: (1) By professor of education; (2) by professor of education and superintendent of schools; (3) by professor of education and head of collegiate department concerned; (4) largely on the basis of membership in senior class. Outside of these the above shows a very marked variation. Attention is here called to the method used at Southwestern University, Hope College, Milwaukee-Downer, and Whitman College. Attention is also called to the number of cases in which the president of the college makes the selection.

HOW THE PRACTICE TEACHING IS SUPERVISED.

Alfred University.—Professor of education gives actual supervision, occasionally assisted by other members of the faculty who have training in education. "Theoretically the class teacher criticizes plans and class teaching also, in practice. I find the teachers, with the exception of the principal, unable to give any help."

Alma College.—Cooperation among superintendent, professor of education, and professor of collegiate department concerned, but plan yet indefinite.

Ashland College.—Usually done by regular class teacher. Later return states that this is done by the ward principal.

Baldwin-Wallace College.—Professor of collegiate department concerned.

Bellevue College.—Regular high-school teachers and professor of education.

Beloit College.—Professor of pedagogy and heads of departments in teachers' courses.

Bowdoin College.—"Principals."

Brown University.—Done by supervising teacher and professor of educational psychology.

Central College.—By assistant professor of philosophy and education.

Clark College.—"The practice teachers were visited by a representative of the State board of education, by the local superintendent, by a representative of the college, and received suggestions more or less from them all."

Coe College.—Not much actual supervision. What is given is done by person in charge of subfreshman class.

College of the City of New York.—Supervised by instructor in secondary teaching.

Colorado College.—Regular teachers, principals, and professor of education, the two latter visiting occasionally.

Cotner University.—Professor of education and regular teachers.

Dakota Wesleyan University.—Regular teacher.

University of Denver.—Principal, occasionally assisted by professor of education.

Doane College.—Professor of education; also regular teacher.

Earlham College.—Superintendent and principal give a course in observation and practice teaching and have full charge of the work.

Elon College.—Professor of pedagogy.

Fairmount College.—"Heads of departments where teaching is done;" that is, the regular teachers.

Franklin College.—Superintendent and high-school teachers.

Geneva College.—Superintendent of public schools.

Grand Island College.—Professor of education and regular teachers.

Greenville College.—By regular class teachers.

Grinnell College.—Report does not reveal how this is done.

Gustavus Adolphus College.—Professor of education and heads of collegiate departments concerned.

Heidelberg University.—Regular class teacher and member of collegiate department concerned.

Hiram College.—Professor of education.

Howard University (colored).—Regular class teacher and member of university faculty.

Hanover College.—"President and head of department in which student majors."

Hastings College.—Professor of education and head of college department concerned.

Henry Kendall College.—No report on this point.

Hope College.—Regular teacher and occasionally help from professor of education.

Juniata College.—Regular teacher and professor of education.

Kalamazoo College.—Regular teachers.

King College.—No supervision.

Lawrence College.—Regular teacher and professor of education.

Lebanon Valley College.—No report.

Lehigh University.—Professor of education.

Lincoln Memorial University.—Professor of education.

Macalester College.—Heads of college departments.

Middlebury College.—Professor of pedagogy.

Milton College.—Regular class teacher.

Milwaukee-Downer College.—Director of department of home economics and city superintendent of same subject. No work in other subjects.

Missouri Valley College.—Professor of education.

Missouri Wesleyan College.—The principal of the academy.

Mount Union College.—Professor of education, head of collegiate department concerned.

Muskingum College.—Regular teacher.

Nebraska Wesleyan University.—Supervisor of practice school.

Oberlin College.—A special supervising teacher helped by high-school principal during summer of 1914.

Ohio Northern University.—Professor of education, assisted by regular teacher or principal.

Ottawa University.—"A general supervisor, an experienced high-school principal, with graduate training in education, supplemented by the various college professors and professor of education."

Otterbein University.—Instructor in methods and regular class teachers.

Park College.—A special supervisor.

Ripon College.—Joint supervision by professor of education, superintendent, and regular teacher.

College of St. Elizabeth.—Regular teachers.

St. Johns University.—"The prefect of studies."

St. Olaf College.—Professor of education and regular teachers.

Shaw University (colored).—No report on this point.

Southwestern University (Tex.).—Principal devotes half of his time to this work. Professor of education and supervising teachers hold conferences with student teachers and visit their classes.

Swarthmore College.—Professor of education, regular teachers and superintendent of schools.

Tarkio College.—Regular teachers.

Temple University.—"High-school teacher and college instructor."

Texas Woman's College.—Regular teachers and professor of education.

Trinity College (N. C.).—No report.

Upper Iowa University.—Professor of education and superintendent.

Whitman College.—City superintendent of schools.

College of William and Mary.—Regular teachers, principal, and professor of education.

Yankton College.—Heads of collegiate department concerned.

York College.—Head of college department concerned.

From the foregoing data the following summary is made: Supervision by professor of education, 7 instances; by professor of education and heads of collegiate departments concerned, 6 instances; by heads of collegiate departments alone, 4; regular class teacher and representative of collegiate departments, 11; by regular class teacher alone, 10; by the principal, regular teachers of classes, and professor of education, 4; by principal, 4; by principal and professor of education, 1; by the superintendent alone, or with other persons, 5 cases.

COST OF USE OF PUBLIC HIGH SCHOOL.

Three different conditions exist with regard to the cost of the use of the public high school by the college: (1) At Bowdoin and Whitman Colleges the student teachers receive remuneration for their services; (2) in 6 others some money is paid by the college for the privilege; (3) and in 20 colleges there is no cost for this service.

Ashland College pays a supervising teacher $100 per year, while Brown University pays each supervising teacher $50 a year. Ohio Northern University grants free tuition to the graduates of the high school if they enter the college. Clark College pays the car fare of the student teacher, and at Middlebury it costs "the time of the supervisor, approximately, $2,400."

The following institutions report that such privileges cost them nothing: Alma, Baldwin-Wallace, Colorado College, Cotner, Fairmount, Geneva, Hiram, Hope, Howard, Lincoln Memorial University, Lawrence, Lehigh, Milwaukee-Downer, Missouri Wesleyan, Oberlin, Ripon, Swarthmore, Texas Woman's College, Trinity College, and Upper Iowa University.

The remainder gave no information, pro or con, as to the cost.

PRACTICE TEACHING WITH LABORATORY SCIENCE.

Alfred University.—"Just as in any other subject."

Baldwin-Wallace College.—"Our science men, regular professors, have supervision."

Bellevue College.—"The practice teacher has charge of the laboratory work under the direction of the regular instructor."

Beloit College.—"This is done in the teachers' courses in the laboratory of each department."

Brown University.—"Student teacher in the laboratory as any other teacher does."

Central College (Mo.).—"The practice teacher is put in full charge of the regular academy class in physics."

Clark College.—"High school furnished the equipment."

Colorado College.—"Practice teachers act as laboratory assistants."

Cotner University.—"Let student be laboratory assistant."

Doane College.—"Practice teacher serves the same as the paid teacher."

Elon College.—"Work done under the supervision of the director of the physical or chemical laboratory."

Fairmount College.—"Supervised by heads of departments."

Grand Island College.—"Student teacher has charge of the laboratory work as a regular teacher."

Gustavus Adolphus College.—"Assist regular teacher in laboratory work."

Hanover College.—"Student works under supervision of college professor of the subject."

Hastings College.—"Student acts as laboratory assistant."

Kalamazoo College.—"Assist with apparatus."

Lincoln Memorial University.—"Teacher of science directs."

Macalester College.—"By quiz work and actual direction of laboratory work in elementary courses."

Middlebury College.—"The same as other subjects."

Milton College.—"Student takes charge as regular teacher."

Milwaukee-Downer College.—"Assist regular teacher during first half of regular weekly period; have responsibility of teaching class during second half of weekly period."

Missouri Valley College.—"Head of department outlines the course. Head of education department supervises method and class management."

Missouri Wesleyan College.—"Practice teacher responsible for both recitation and laboratory work."

Mount Union College.—"Under head of department."

Nebraska Wesleyan University.—"Usually student serves as laboratory assistant and is supervised by head of department concerned and also by the practice supervisor."

Ohio Northern University.—"Student has charge of laboratory as well as class work."

Ottawa University.—"Supervisor and college teacher cooperate in recitation and visitation, organization and planning."

Park College.—"Student teacher under direction of regular professor."

Ripon College.—"Acts as laboratory assistant."

College of St. Elizabeth.—"The student conducts the class under the supervision of the regular teacher and in presence of class in pedagogy."

St. Olaf.—"Acts as laboratory assistant."

Southwestern University.—"We have physics taught in the college laboratory."

Susquehanna University.—"Under direction of college teacher of science."

Upper Iowa University.—"Acts as laboratory assistant."

Yankton College.—"Acts as laboratory assistant."

York College.—"Teacher works under head of department."

Eighteen of the colleges made no reply. Seventeen stated that they gave no such work, and several others that they avoided it. Thirty-seven try to manage the work in some form. This shows that not much real work is being done in laboratory sciences for student teaching among the smaller colleges.

In 10 of the 37 institutions, the student teacher acts as laboratory assistant; in 13 the student teacher has charge of the work as regular teacher. Other facts about this work refer to various details of supervision of the teaching.

SUGGESTIONS AS TO ORGANIZATION AND ADMINISTRATION OF PRACTICE TEACHING.

Alfred University.—"Daily conferences are necessary for efficient work."

Bellevue College.—"Careful supervision and conferences necessary."

Beloit College.—"In the teachers' courses there is more or less teaching practice. I think practice teaching done in this way is more helpful than any done on the high school."

Colorado College.—"I think nothing can beat work done under actual public school conditions. We have found that we can help the schools and they give us valuable help."

Elon College.—"Should be under the charge of department of education and heads of college departments concerned."

Franklin College.—"A cooperative arrangement between public high school and college is best. Supervising teacher should be head of department in high school and give special methods course in college."

Gustavus Adolphus.—"A practice school is better than a public high school for this work."

Howard University.—"A high school under control of department of education is best."

Juniata College.—"Best to affiliate with a public high school."

Lawrence College.—High school should be under control of department of education.

Lincoln Memorial University.—Use your own secondary school and supplement the work by visits to public schools.

Macalester College.—There should be a half-year of student teaching required by State law.

Missouri Valley College.—Practice teaching should be under the joint supervision of department of education and collegiate departments concerned.

Missouri Wesleyan College.—"Observation should accompany both methods, courses, and practice teaching."

Ohio Northern University.—"A plan like that at the University of Missouri is preferable to a public high school."

Upper Iowa University.—A cooperative system between colleges and public high schools is best.

From these statements it is evident that opinion varies much among the colleges. Five recommend outright a separate ("own") practice school. Three recommend a public high school and a plan of cooperation between college and high school. As to supervision, three recommend joint supervision by department of education and collegiate departments concerned.

STATE AGRICULTURAL COLLEGES.

Student teaching for prospective secondary teachers.

Names.	Secondary school used.		Number of prospective teachers.	Amount of teaching done (semester hours).	How selected.
	Own.[1]	Public.[1]			
Iowa State College of Agriculture		×	50	2/3	Elective.
Kansas State Agricultural College	×		100	(2)	Do.
Michigan Agricultural College		×	40	(3)	By heads of Dept.
Mississippi Agricultural College			18		
Oklahoma Agricultural College			10-20	(4)	By Dept. of Educ. and Dept. in college.
Purdue University		×	30	3	Seniors in Dept. of Educ.
Total	1	3	248-258		
Average			41-43		
Median			40		

[1] The cross (×) means yes. [2] Twelve weeks. [3] One to three weeks. [4] Varies.

Mississippi Agricultural College uses the subfreshman class for practice teaching, and Oklahoma Agricultural College uses "any opportunity available." It is not possible to generalize as to the amount of teaching done, but the tendency as to number of teachers seems to be about 40 per institution.

The work is supervised as follows: Kansas State Agricultural College, by associate professor of education; Michigan, by heads of departments of home economics and agricultural education; Mississippi, by professor and associate professor of education and sometimes by head of department concerned; Purdue University, by superintendent of schools and professor of education.

Two suggestions as to organization come from these colleges: (1) All concerned with this work should be trained in education and in their special subject; (2) the practice work should be entirely under the control of the college.

SUMMARIES AND CONCLUSIONS.

Total questionnaires sent out	295
Replies received	182

STATE UNIVERSITIES.

State universities replying	30
State universities not giving practice teaching for secondary teachers	10
Per cent	33.3
State universities planning to give such work	6
Per cent	10.0
State universities giving such work now	20
Per cent	66.6
State universities using own secondary schools	8
Per cent	26.6
State universities using public high schools	11
Per cent	36.6
Average number of student teachers each year	32-34

Median number of student teachers each year	30
Average amount of teaching in semester hours	4 4/19–4 13/19
Median amount of teaching in semester hours	5

NONSTATE UNIVERSITIES.

Number replying	13
Use own high school	2
Use public high school	11
Average number of teachers each year	41
Median number of teachers each year	30
Average amount of teaching in semester hours	4–4. 8
Median amount of teaching in semester hours	4. 55

OTHER UNIVERSITIES AND COLLEGES.

Number replying	133
Number using own high school	46
Per cent	35
Number using public high school	35
Per cent	27
Average number of teachers each year (in 57 institutions)	12. 3
Median number of teachers each year (in 57 institutions)	10
Average amount of teaching, in semester hours (in 31 institutions)	3. 08
Median amount of teaching, in semester hours (in 31 institutions)	2. 5

STATE AGRICULTURAL COLLEGES.

Number replying	6
Number using own high school	1
Number using public high school	3
Average number of teachers each year	41–43
Median number of teachers each year	40

Amount of teaching done varies from two-thirds semester hour to about three semester hours.

GRAND TOTALS.

1. Number of institutions giving practice teaching for secondary teachers.	119
Per cent of those replying	90
Per cent of those to whom questionnaires were sent	40
2. Number of institutions using own high schools	57
Per cent of those replying	43
Per cent of those to whom questionnaires were sent	20
3. Number of institutions using public high school	60
Per cent of those replying	45
Per cent of all institutions included	20
4. Average number of student teachers each year (in 95 institutions)	19. 5–20. 5
5. Average amount of teaching done by student teacher, in semester hours (in 74 institutions)	3. 98

METHODS OF SELECTING STUDENT TEACHERS.

In most cases it is evident that the student teachers must have had certain courses in educational theory and in the subject they will teach before doing this teaching. This condition seems to be quite universal. In many cases, in all types of institutions, the actual selection is made either by a representative of the department or school of education, or by such representative and persons connected with the collegiate department concerned. In a great many places it is elective; in others it is required, if the prospective teacher desires a degree, or a certain type of teachers' license, or both. In some places where cooperation exists between the institution and the public high school, a representative of the public high school shares in the selection of the teacher. In no case is it evident that a scholarship standard is adhered to in making such selection. In no case is it evident that any physical or moral qualification is adhered to in selecting these teachers. From the data found here it seems evident that there is need of a carefully planned system of selecting the student teachers.

HOW THE STUDENT TEACHING IS SUPERVISED.

All varieties of supervision exist, from practically little or no supervision to close and careful supervision. Often a representative of the department of education and a representative of the collegiate department concerned do this work. In several cases—20 in number—it is evident that the staff of the department or school of education have full supervision of this work. The typical arrangement is a combination of a representative of the department of education with some other person or persons. There are about 50 examples of this. In several places the supervision is conducted by persons who have practically no connection with the department or school of education. Practically no statements are made as to how this work is carried out.

THE COST OF THE USE OF THE PUBLIC HIGH SCHOOL.

With reference to this item, the following conditions exist: (1) In many places there is no item of expense for this service; (2) in several instances a flat fee is paid the public-school authorities for this service; (3) in some institutions the service rendered by the student-teacher to the high school is considered a return for the privilege of practice teaching; (4) in some few cases the student-teacher receives some income for the service rendered. This takes the form of payment of expenses, car fare, or the regular wages of a substitute teacher; (5) several institutions grant scholarships in return for this privilege. The most typical situation is one in which no cost item appears and in which there is cooperative effort between the institution and the public high school.

ADMINISTRATION OF PRACTICE TEACHING IN LABORATORY SCIENCES.

In most institutions no practice teaching in laboratory sciences is being done. Where it is, one of two plans is used. In one the student teacher is the laboratory assistant, and by such work learns what he can about the teaching of the subject. By the other plan the student-teacher is given actual charge of the work, class work and laboratory work, under supervision. In many cases this work is done in college laboratories, not in laboratories designed for secondary schools.

SUGGESTIONS FOR ORGANIZATION AND ADMINISTRATION.

The suggestions for organization and administration show less unanimity than the description of actual conditions. For example, Beloit champions the old plan of the student-teacher teaching the class of which he or she is a member. Others flatly declare that student teaching under actual high-school conditions is the best. Still others insist that a practice school shall be a part of the institution, and not a part of the public-school system. The majority favor using the secondary schools for this purpose, not using college classes or upper grades. A few favor using the seventh and eighth grades, as well as a high school.

SOME INTERRELATIONS OF DEPARTMENTS OR SCHOOLS OF EDUCATION.[1]

By W. G. CHAMBERS.

This study was based on returns from the following questionnaire:

1. Are any courses offered in your institution, especially for teachers, either in special method (*e. g.*, the teaching of German), or in special subject matter, by members of other faculties than yours? If so, are they—
   - (*a*) Listed among the courses of your school only?
   - (*b*) Listed among the courses of other faculty only?
   - (*c*) Listed among the courses of both faculties?
2. Do you control such courses wholly or partially?
3. Are they given only at your request or independently of your desires?
4. Are teachers giving such courses considered members of the education faculty?
5. Do they draw any portion of their salary from your budget?
6. Is your practice teaching ever supervised by members of other faculties, *e. g.*, a professor of Latin? If so—
   - (*a*) What is his official relation to your faculty?
   - (*b*) Is the practice teacher more directly responsible to him or to you?
7. What do you consider the ideal arrangement of these relations?

TABULATION OF REPLIES.

Replies were received from 34 institutions, but only 30 were used in the following tabulation:

I. (*a*) Are any courses offered especially for teachers either in special method or in a special subject matter, by members of other faculties than the education faculty?

	Institutions.	Per cent.
Yes	25	83.3
No	4	13.3
Course listed but not given	1	3.3
(*b*) Such courses are listed in the bulletins—		
Of education department only	3	10.0
Of academic department only	5	16.6
Of both departments	16	53.3
No replies (or no separate bulletins)	6	20.0
II. How are such courses controlled?		
Wholly by the education faculty	2	6.6
Partially by the education faculty	16	53.3
Wholly outside the education faculty	8	26.7
No replies	4	13.3

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[1] This and the papers following constitute for the most part investigations by a committee of the college teachers of education. See note on p. 7.

III. Are the courses given only at request of the department of education or independently of its desires?

	Institutions.	Per cent.
By request only	17	56.7
In some cases by request, in some cases independently	2	6.6
Without any request	6	20.0
No reply	5	16.7

IV. Are the teachers giving such courses considered members of the education faculty?

Yes	6	20.0
No	15	50.0
Planning for such membership	1	3.3
In a special case only	1	3.3
Faculties not separate	2	6.7
No reply	5	16.7

V. Do such teachers draw any part of their salary from the education budget?

All of it	0	0.0
Partially	4	13.3
None of it	15	50
Have no separate budget	6	20
No reply	5	16.7

VI. Is practice teaching ever supervised by members of other faculties?

Yes	6	[1] 20
No	20	[2] 66.7
No practice teaching	4	13.3

Of the 6 institutions which have practice teaching supervised by an academic department, 5 have given the supervisor a minor position on the education faculty; in the other he has no connection with the faculty. In 3 of the 6 institutions the practice teacher is chiefly responsible to some member of the education faculty, which means that supervision is a cooperative arrangement; in one the practice teacher is responsible to an academic department for scholarship (subject matter) and special method and to the education department for general method; in another he is responsible to an academic department for subject matter and special method, and to the principal and supervisors of the training school for "discipline and personality," and in the last he is responsible to an academic department for special method and to the education department for general method.

It appears, therefore, that in none of the 6 cases reported is the supervision more than equally shared with an academic department.

VII. What would be an ideal arrangement in view of these relations?

The data submitted under this head do not lend themselves easily to quantitative tabulation. Of the 30 replies tabulated, 5 made no suggestions whatever under this topic; 9 suggested the plan under which their several institutions were working as the best plan for them; and 16 gave, in most cases very briefly suggestions representing partial or complete variation from their respective practices. The communication rejected from the above summaries, because the institution from which it came was organized independently and therefore did not conform to the conditions being investigated, contained some helpful suggestions which are included here with these last 16.

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[1] 23 per cent of those having practice teaching.

[2] 77 per cent of those having practice teaching.

The 26 returns which gave suggestions as to an ideal adjustment of the relations of academic and professional departments for courses in special method and for supervision of teaching fell into seven general groups:

1. There is, first, a group of 5 papers which do not suggest any scheme of cooperation, but which mention some general principle important in the operation of any plan, or the replies of which are too brief or indefinite to permit of classification. *All alike suggest the importance of control by the department of education.*

2. The second group of 5 papers favors *complete independence of the education faculty in all special courses;* and while 4 of the contributors make no reference to supervision of teaching it is safe to assume that they would limit that function equally.

3. A single contributor, after describing the plan in his own school of giving all courses in special method and directing the work in observation (they have no practice teaching) through members of the education faculty, and of limiting the academic departments to courses in special subject matter, concludes:

"I think that this is the ideal division of work, except for the entire lack of control of the subject-matter courses."

4. Three others describe their own practice of arranging with the academic departments for courses in special method and subject matter and of limiting their supervision wholly to their own faculty, and express themselves as satisfied with the plan.

5. The largest group, consisting of 9 papers, favor cooperation with academic departments, both for special courses and for supervision, although, in a majority of cases, they emphasize the necessity of special educational training or public school experience on the part of the academic cooperator.

6. One institution with an almost complete independent organization submitted, through its dean, a description of its own organization and declared it to be satisfactory. This plan includes courses in special methods by the education faculty (while also accepting courses offered by academic departments) and supervision by members of the high-school faculty of the training school.

7. Finally, two of the contributors favor placing both supervision and special methods courses in charge of specially qualified teachers of the secondary schools in which the practice teaching is done.

SUMMARY AND CONCLUSIONS.

In spite of the variety of opinion which is shown in the data just reviewed concerning the particular scheme of cooperation between academic and educational departments which should be adopted, there is fair unanimity as to certain principles which should have recognition in any plan which may be adopted. Some of the more important principles which seem to have general acceptance are the following:

1. Some form of cooperation is essential. As universities are now organized a department, or even a school, of education can not furnish all the elements which are essential in the training and equipment of a teacher for secondary or higher schools. While certain disadvantages arise out of this dependence on other departments, there are perhaps greater advantages arising out of the more general university atmospheres, out of the wider range of interests and the more miscellaneous personal associations, than could be had in a more narrowly limited, even though the wholly professional, institution such as a State teachers' college.

2. All courses, instruments, and agencies in the universities which have for their chief purpose the instruction, training, or equipment of teachers should be centralized in the department or school of education, should be established only on the initiative of the education faculty, and should remain wholly under its control. In no other way can efficiency be secured or wasteful and irritating duplication be avoided. In no other way can a professional enthusiasm be aroused or a sense of professional loyalty be developed. No academic department should have the right to announce even a course in subject matter, especially for teachers, without first consulting and getting the approval of the education faculty. This faculty has for its chief function the promotion of the interests of teachers, and should, therefore, be the best judge of the fitness, the importance, and the need of proposed courses for teachers. Where the interdepartmental relations are what they should be, the education faculty will ordinarily be glad to get as many courses of special subject matter for teachers as possible, provided they are adapted to their end. It would follow, also, that the department of education should have the right to suggest changes of method and of subject matter in these special courses as well as the right to some voice in the selection of the instructor from among the available members of the academic department concerned.

3. Such special courses should be announced primarily in the bulletin of the department or school of education, and if announced elsewhere should be specially designated as given in or for the department or school of education.

4. The right to initiate and control implies also the obligation to finance a course. Therefore all teachers of courses accepted by the education faculty and announced in the bulletin as especially for teachers should draw a proportionate share of their salary from the education budget. This arrangement will have the double advantage of (1) giving the academic instructor a sense of responsibility to the department of education and (2) of making the education faculty reasonably conservative in initiating or accepting special courses for teachers.

5. Cooperation with, responsibility to, and the receipt of salary from the department of education should imply some official connection with that faculty. Just how close that connection should be—whether it should constitute full membership, with the right to vote on all matters of policy; whether it should grant only the right to discuss and recommend; whether it should limit the instructor to the right to attend only occasional faculty meetings in which students' work is discussed; or whether it should stop short with the privilege of advising students personally as to their work in his special course—does not appear from the data submitted. For the present, therefore, the extent of the participation of the special academic instructor in the affairs of the education faculty must be determined by local conditions.

6. Courses in special method should be in the same hands as the supervision of practice teaching. The intimate interdependence of special method and practice teaching is implied in the attitude of three of the groups discussed above, viz: (1) Those who would keep courses in method and supervision of teaching wholly within the education faculty, (2) those who would secure both through cooperation with the academic departments and (3) those who would delegate both functions to the high-school faculty in which the practice teaching is done. Only 4 of the 21 who gave constructive suggestions imply the separation of supervision and special method. The essential interdependence of these two important aspects of teachers' training seems to the writer almost axiomatic, whether teaching is to be regarded as the application of the principles of method, or whether special method is to be regarded as the organization of the experience gained in teaching.

Eliminating the suggestions which violate any of the above principles, and ignoring certain differences as to minor details, we may reduce the constructive suggestions of our contributors to three distinct schemes.

1. No cooperation whatever with academic departments. In this scheme the academic departments give only the academic courses which they offer for students of all departments regardless of their

vocational aims, while all special courses for teachers and all supervision of teaching are kept within the education faculty.

The advantages of such a plan are:

(1) Complete control of all professional work and the opportunity to develop a professional consciousness without interference.

(2) Freedom from outgrown academic traditions as to educational values and principles of method which eliminates the evil of conflict between the fundamental principles of general and special method, on one hand, and between special method and criticism of teaching, on the other hand.

The objections to the scheme are equally obvious:

(1) Unless the education faculty includes the teachers of the practice school there is the objection:

(*a*) That special method and supervision of teaching are artificially separated if the latter is in charge of the practice school teachers, or

(*b*) That supervision becomes academic, formal, and lacking in dynamic force if it is exercised by the education faculty alone.

(2) It fails to get any cooperation from the academic departments which through lack of sympathy keep many of the prospective teachers majoring with them out of the department of education.

2. Cooperation with the academic departments both for courses in special method and for supervision of teaching. This is probably the most practical of all the schemes proposed for the present conditions under which most departments of education are compelled to work.

Its advantages are:

(1) It secures the cooperation of the academic departments (at least theoretically) and forestalls the establishment of rival courses.

(2) It preserves the natural interdependence of subject matter and method, on one hand, and of theory and practice, on the other hand.

(3) Experience in supervision may react so as to vitalize the content and improve the method of the subject matter courses in the academic departments.

(4) It puts the education faculty in a position to appeal for concessions and adjustments for which it could not otherwise ask with any reason or hope of success.

But it is impossible to overlook some unmistakable objections to this plan:

(1) It is rarely, indeed, that the holders of academic chairs have had either the training in educational theory or the practical experience in teaching in elementary or secondary schools essential in the organization of a course in special method or in constructive criticism of teaching.

(2) Extreme specialization in advanced subject matter is likely to have given the academic specialist a warped perspective in the determination of relative educational values of subject matter within his own field, for purposes of secondary or elementary education, or as between his subject and other subjects of the curriculum.

(3) There is the danger that the best qualified members of the academic department will be more interested in research or in the advanced courses of the department and will therefore give only perfunctory attention to the education courses, or worse still, intrust them to poorly prepared or inexperienced subordinates.

3. Both the courses in special method and the supervision of teaching conducted by heads of the several departments of the school in which practice teaching is done, who are made regular members of the education faculty. This involves the limitation of the academic departments to subject matter courses as in the first scheme discussed above, but it differs from that plan in the utilization of the training school faculty for methods courses and supervision. There is much to be said in favor of this plan, especially in institutions which have well-organized practice schools or in urban communities which can afford to employ well-trained and specially qualified teachers in the public elementary and secondary schools.

In favor of this plan are the following considerations:

(1) It has both the advantages claimed for the first of the three plans under consideration.

(2) It insures a closer organic relation between the courses in general educational theory and the actual teaching experience of the students than any other plan.

(3) It avoids the danger of making the work in special method formal and academic and insures a greater concreteness and vitality through closer correlation with the practice work.

(4) It avoids the three objections offered to the plan of cooperation with academic departments.

(5) It places both method and supervision in charge of teachers who are specialists and whose main interests lie in the field of this work, and who are able to adapt it to the actual conditions and standards under which teachers must actually work better than could any teacher whose interests are chiefly academic and in a higher field. That is, it projects the preparatory work on the plane and in the field where the actual professional service is to be rendered later.

Some of the weaknesses of this plan are indicated in the following points:

(1) It fails to secure the cooperation of the academic departments—an objection offered to the first plan discussed.

(2) It separates the special method from the advanced subject matter of its department and thus is deprived of the advantage of specialized scholarships—unless, of course, teachers may be secured for the supervision work who have specialized in the academic aspects of the work as well as in education. It is thus open to the criticism of sacrificing scholarship to professional interests.

(3) The employment of teachers in secondary or elementary schools to assist in the work of preparing teachers in university departments has the appearance of lowering the standards of the university. The obvious reply is that these teachers must meet the best university standards as to training and experience; an ordinary secondary teacher could no more do this work than he could occupy a university chair of physics or Greek.

THE RESULTS OF PRACTICE TEACHING ON TEACHING EFFICIENCY.

By H. G. CHILDS.

During the six years covered by this investigation, 124 students have completed a course in practice teaching in the Bloomington (Ind.) High School under the supervision of critic teachers in the departments of English, history, mathematics, botany, geography, and zoology.

During the first three years of this period the course was completed in 12 weeks. Because of this, three separate student groups were able to receive training during any year. This accounts for the relatively large enrollment in these courses for these years. For the past four years the work has been carried on on the semester basis.

During the year 1913–14 practice work was offered in but one department, history. During the year just closed practice teaching has been offered in English, history, and botany. In the history department, however, the critic has devoted but one-half year to the work.

The table following indicates the distribution of practice teachers by departments:

Numbers by departments.

Date.	English.	History.	Mathematics.	Botany.	Geography.	Zoology.	Total.
1908–9	13	4	7	1	0	1	26
1909–10	16	2	7	2	0	0	27
1910–11	11	6	2	3	1	0	23
1911–12	9	3	4	4	0	0	20
1912–13	13	3	2	1	0	0	19
1913–14	0	9	0	0	0	0	9
1914–15	9	4	0	2	0	0	15
Total	71	35	22	13	1	1	139

PURPOSES OF THIS STUDY.

The purposes of this study were to determine (1) the valuation the teachers who had taken the practice teaching placed upon it as an aid in later teaching; (2) the estimate city superintendents place upon the quality of teaching done by our practice teachers without previous experience during their first year in the public schools as compared with other teachers.

VALUE OF PRACTICE TEACHING AS ESTIMATED BY THE TEACHERS.

Letters of inquiry were sent to 115 of the 124 teachers who had completed the practice course up to June, 1914. The remaining 9 could not be located. Eighty-one replies were received, and 6 letters were returned unclaimed. The remaining 28 either did not care to reply or neglected to do so.

The 81 replies received indicate that 79 of these practice teachers entered the teaching profession after graduation or leaving the university. One is continuing her work as a graduate student at Indiana University, and one married shortly after completing the practice work.

Of the 79 who entered the teaching profession, 41 had experience in teaching previous to their practice work and 38 had no such previous experience.

The following indicates the replies of these 79 teachers to item (1) of the letter, which reads as follows: "Will you write frankly whether you consider the course in practice teaching has been of much, moderate, or little benefit to you as a teacher."

Teacher's estimate.

	Much.	Moderate.	Little.	Total.
1. Teachers with previous experience in teaching	33	6	2	41
2. Teachers without previous experience	36	2	0	38
Total	69	8	2	79

Six of these teachers stated that this course was the most valuable one they had taken in the university. Eight others spoke in extra-superlative terms, such as: "Very much," "of the greatest benefit," "invaluable," etc.

From the above it is apparent that the testimony of the teachers themselves overwhelmingly attests the value of practice teaching.

COMPARISONS BY SUPERINTENDENTS.

To secure further evidence of the value of practice teaching, letters were sent to superintendents to whom our practice teachers had gone for their first teaching after taking the practice course. As it seemed impossible to determine whether a teacher's success was due to his previous teaching experience or to his practice work, inquiries were sent out regarding only those teachers with no previous teaching record.

In the letter superintendents were asked to rate teachers on their first year's work as "superior," "above average," "average," "below average," and "unsatisfactory" as compared with all other teachers in the teaching force of the school, and also to make a similar comparison of the teacher in question with other inexperienced teachers in their teaching staff.

Thirty-eight teachers without previous experience replied to one inquiry. In nine of these cases the superintendent with whom they first taught could not be located. Twenty-nine letters were sent to superintendents and 19 replies were received indicating the following ratings:

Superintendents' ratings.

	Compared with all teachers.	Compared with inexperienced beginners.
Superior	3	6
Above average	7	8
Average	7	4
Below average	2	1
Unsatisfactory	0	0
Total	19	19

This tabulation indicates that 10 of the 19 teachers were decidedly above the average of all teachers in the teaching staff; 17 of the 19 were equal to or above the average of all; but 2 were below average, and none were reported as unsatisfactory. The comparison with other teachers with no previous teaching experience is still more striking, as 14 of the 19 were rated decidedly above the average; 1 only was rated as below average, and none were rated as unsatisfactory.

CONCLUSIONS.

Although our data are too meager to generalize upon too broadly, the above facts would seem to warrant the conclusion that in the judgment of superintendents of schools, as attested by their ratings, one semester of high-school practice teaching under a competent critic produces a more successful teacher than does the two, three, or four years of schoolroom experience of the teacher not so trained.

The testimony of the teachers themselves is almost unanimous in favor of practice teaching.

THE RESULTS OF PRACTICE TEACHING ON THE PUPILS TAUGHT.

By W. S. GRAY.

The purpose of this investigation was to determine the efficiency of pupils who had been taught by student teachers as compared with the efficiency of public-school pupils. This question is an important one, because the efficiency of instruction in training schools is seriously questioned in many centers where practice-teaching facilities are desired. In order to secure information on the point in question, the standing of training-school pupils was compared with the standing of public-school pupils during the first year in high school. The sources of data were the records of 1,500 pupils entering high school, of which 430 were records of pupils from four normal training schools of Illinois and from the elementary school of the University of Chicago, and 1,070 were records of public-school pupils.

The initial study was made in 1913. It included records of all pupils entering four high schools in September, 1911, and September, 1912. The computations were based on the average records of pupils in all subjects during the first semester in high school. Records for different schools were not combined because of differences in school conditions and methods of grading.

Table 1 presents the results in summary form. The letters A, B, C, and D in the horizontal row at the top of the table refer to the four high schools. N refers to normal training school pupils and P to public-school pupils. The numbers in parentheses after N and P refer to the numbers of pupils involved. The numbers to the left of the table refer to the five quintiles into which the records of schools A and B were divided. The letters between the summaries for school B and school C refer to grades given to pupils in schools C and D. The entries in the table give the percentages of training-school pupils and public-school pupils in each group. The average grades are given at the foot of the table.

TABLE 1.—*Summary of records of pupils in four high schools.*

Quintiles.	A		B	
	N (29).	P (52).	N (83).	P (113).
1	35	11	15	23
2	24	18	22	18
3	17	22	24	19
4	24	18	20	20
5	0	31	19	20
Average	81	71	78.3	78.7

Grades.	C		D	
	N (73).	P (75).	N (19).	P (51).
A	3	5	5	17
B	23	24	42	41
C	15	28	37	25
D	23	24	16	17
E	33	19	0	0
F	3	0	0	0
	D	C	B	B

The table shows the following facts:

(*a*) Training-school pupils are superior in school A, as shown by the averages and by the percentages of pupils in quintiles 1 and 2.

(*b*) Public-school pupils are slightly superior to training-school pupils in school B.

(*c*) Public-school pupils are somewhat superior in schools C and D.

(*d*) Study of 1913 reveals distinct superiority of training-school pupils in one high school and slight superiority of public-school pupils in three high schools.

Table 2 presents separate summaries of the autumn, winter, and spring term records of a class entering high school B in September, 1915, and a summary of the autumn term records of a class entering the same high school in September, 1916.

TABLE 2.—*Records of pupils entering high school B in September, 1915, and September, 1916.*

Quintiles.	Autumn, 1915.		Winter, 1915-16.		Spring, 1915-16.		Autumn, 1916.	
	N (23).	P (26).	N (20).	P (26).	N (20).	P (25).	N (23).	P (39).
1	17	23	20	19	25	16	22	18
2	22	19	10	27	15	24	22	20
3	17	19	25	19	15	24	26	19
4	17	23	20	19	20	20	17	20
5	27	16	25	16	25	16	13	23
Average	80	81	80	82	80	81	80	79

Table 3 presents separate summaries of the first-semester records in high schools E for 1915 and 1916. The records are summarized in terms of the general averages and of the grades in English, algebra, and general science for 1915, and in terms of the general averages and of the grades in English, algebra, and ancient history for 1916.

TABLE 3.—*Records of pupils in high school E for 1915 and 1916.*

IN 1915.

Quintiles.	Average.		English.		Algebra.		General science.	
	N (10).	P (28).	N (10).	P (28).	N (10).	P (28).	N (10).	P (28).
1	30	18	20	21	30	18	40	13
2	20	18	20	18	20	18	40	9
3	20	18	20	18	30	14	10	22
4	30	18	30	18	10	25	10	26
5	0	28	10	25	10	25	0	30
Average	85	82	87	86	83	80	88	81

IN 1916.

Quintiles.	Average.		English.		Algebra.		Ancient history.	
	N (22).	P (19).	N (22).	P (19).	N (22).	P (19).	N (22).	P (19).
1	9	32	14	26	14	26	18	21
2	23	16	14	26	18	21	14	26
3	18	26	27	17	23	21	18	26
4	23	16	31	5	18	21	23	16
5	27	10	14	26	27	11	27	11
Average	84	86	90	92	84	87	83	86

Table 4 presents separate summaries of the records of pupils entering high school C in September, 1915, February, 1916, and September, 1916.

TABLE 4.—*Records of pupils entering high school C in September, 1915 and 1916.*

Quintiles.	September, 1915.		February, 1916.		September, 1916.	
	N (13).	P (12).	N (17).	P (10).	N (16).	P (13).
1	31	8	35	0	12	31
2	23	17	12	30	19	23
3	16	25	12	30	12	23
4	15	25	12	30	32	8
5	15	25	29	10	25	15
Average	86	85	86	84	85.5	87

Averages of three entering classes:

46 normal-school pupils	86
35 public-school pupils	85.5
25 tuition pupils	86

Tables 5, 6, and 7 present three of a series of studies which has been made by Principal Johnson, of the high school of the University of Chicago, to determine the relative standing of pupils from the University Elementary School and from public schools. The following quotation explains the organization of the table:

> It is obvious that if the pupils from the elementary school were in all respects like those from other schools, a certain percentage of them should be distributed through each quintile in each of the subjects. Thus, since there are 213 taking English and 69 of them come from the elementary school, we might expect 32.4 per cent of each quintile to be from the elementary school. Table 5 shows in detail how far the facts depart from this expectation. In the first column of figures at the left of Table 5 is recorded the total registration in each subject. In the second column the number of pupils from the elementary school is recorded. In the third column is shown the percentage of University Elementary School pupils in each subject. In the other columns appear the variations in each subject from the normal or expected percentage. In the first and second quintiles an excess represents an unfavorable showing for the University Elementary School, while a deficiency (—) represents a corresponding favorable showing; in the fourth and fifth quintiles an excess represents a favorable and a deficiency an unfavorable showing.

TABLE 5.—*Averages in different subjects for 1910–11.*

Subjects.	Total pupils.	University Elementary School pupils.	Per cent.	Quintile.				
				1	2	3	4	5
English	213	69	32.4	−18.4	4.8	11.8	10.5	−8.6
Latin	164	59	36.0	−11.8	− 2.7	3.4	15.5	−1.6
Mathematics	206	67	32.5	−18.2	12.7	6.5	−5.7	5.0
Science	144	27	18.8	− 2.1	−12.7	−9.0	2.6	13.3
French	48	38	79.2	− 6.5	7.3	−1.4	9.7	−1.4
Design	201	65	32.3	− .6	− 2.4	−2.3	10.2	−4.1
Total	976	32.5	33.3	−10.3	.9	3.3	6.6	− .1

TABLE 6.—*Averages in different subjects for the first semester, 1913–14.*

Subjects.	Total pupils.	University Elementary School pupils.	Per cent.	Quintile.				
				1	2	3	4	5
English	68	34	50.0	− 7.1	14.3	0.0	−19.2	11.5
Latin	48	28	34.2	−14.2	15.8	35.8	12.5	−32.0
French	19	14	73.7	−23.7	26.3	1.3	1.3	− 7.0
German	27	17	63.0	−13.0	20.3	17.0	3.0	−23.0
Mathematics	63	31	49.2	−26.1	10.7	27.7	25.8	−15.9
Total	225	124	55.1	−16.8	8.7	16.6	3.0	−12.2

TABLE 7.—*Averages in different subjects for the first semester, 1914–15.*

Subjects.	Total pupils.	University Elementary School pupils.	Per cent.	Quintile.				
				1	2	3	4	5
Latin	74	32	43.2	− 3.2	−36.6	3.4	23.4	13.9
English	95	44	46.3	1.0	− 9.5	16.9	−4.2	−4.2
Science	55	10	18.2	− .1	− 1.0	−1.0	−9.1	9.1
German	32	23	71.9	−29.0	13.8	14.7	14.7	−5.3
Mathematics	93	42	45.2	− 3.1	− 8.4	2.2	4.8	4.8
Music	95	44	46.3	− 4.2	4.2	1.0	11.6	4.2
Physics—C	93	44	47.2	−20.9	−10.4	.5	8.3	21.7
Total	537	239	44.5	− 6.9	− 9.6	4.5	6.4	6.0

These data show the following conditions:

(1) That judging upon the basis of the standings of pupils, the claim made that the effects of practice teaching on pupils taught are injurious, lacks substantiation.

(2) That judging from the same basis, no marked advantage accrued to either training school or public school pupil. That is, the efficiency of one school was about as great as the other.

(3) That on the same basis, the claims of superiority made by either type of school lack confirmation.

BRIEF DESCRIPTIONS OF COMPLETELY ORGANIZED SYSTEMS OF PRACTICE TEACHING.

The plan of organizing practice teaching varies greatly in different colleges and universities of the country. Rather detailed description of the plan in 14 institutions follows. The tendency everywhere is to make provision for practice teaching. In the colleges of agriculture and mechanic arts it is quite common to make use of the school of agriculture of secondary grade upon the campus. This plan is followed in the College of Agriculture, University of Minnesota. Regular classes in the school of agriculture have been handled in full by students in education desiring the opportunity for practice teaching. At the Kansas State Agricultural College the school of agriculture contains 500 pupils, the principal of the school is an associate professor in the department of education, and the work of the school is used regularly for observation and practice teaching. At the Iowa State College of Agriculture and Mechanic Arts, most of the work is done in the Ames public schools. The home economics work from the fifth grade through the second year high school is directly in charge of the critic teachers furnished by the college and the teaching is done by senior home economics students who are preparing to teach. The agriculture in the Ames high school is also in charge of an assistant professor of the department of agricultural education and the work is used constantly for observation and practice teaching purposes. The director of practice teaching in home economics is an associate professor in the department of agricultural education. Provision is being made for observation and practice teaching opportunities on the campus to supplement the work being done in the public schools.

Southwestern University, Georgetown, Tex., has a system which includes its own secondary school. It serves very well the community as a high-grade secondary school and the college as a laboratory for teacher training. The school has been a source of revenue to the college, a possibility in such communities. The management of the work is in the hands of the professor of education.

Brown University was one of the first institutions, if not the first, to place practice teaching for secondary teachers upon a graduate basis. This makes possible a high-grade type of training quite impossible in institutions in which this is a part of the undergraduate work. (See bibliography.)

Harvard University has developed a cooperative system in which it utilizes the public schools. A high grade of work is being done, and it is increasing in scope.

Iowa State Teachers College combines its training school with the school system of the town, and the town school in one district thereby becomes the training school. This is a possibility in any community.

Miami University has developed a high school under its own control. The attendance is growing. The supervision of the practice work is excellent.

Ohio State University has developed a system of cooperation with the public high schools of the city of Columbus, Ohio. It also utilizes some of the high schools in the near-by towns, particularly for practice work in home economics. The supervision is exercised jointly by the regular teachers and by regular supervisors from the staff of the college of education. The work is developing very rapidly, partly as a result of recent State legislation and partly because of the ability of the college to provide actual high-school facilities for this training.

The School of Education of Iowa State University had, until recently, an organization very similar to that utilized by the school of education at Indiana University. Now a complete reorganization is in progress.

The detailed statements of the work at various institutions follow.

BROWN UNIVERSITY.

By W. B. JACOBS.

Brown University began the work in practice teaching for secondary school teachers in 1895. The work at Brown University has consequently been pioneer work and has had over 20 years of successful operation. During these years many modifications have been introduced, but the fundamental principles adopted in the beginning are still maintained. These are:

1. Practice teaching should be open only to graduate students; that is, students who hold a bachelor's degree. This rule is inflexible and has never been broken. Brown University looks askance upon the custom which has developed of including practice teaching and extended professional preparation as part of the four years' work for the first college degree and regards it as a lowering of standards.
2. Practice teaching should be under actual schoolroom conditions. Hence Brown University uses for its practice teaching the public and private secondary schools of the city of Providence and neighboring cities and towns.
3. Practice teaching should include the continuous instruction and control of a class for a long period. At Brown University the amount of practice teaching required varies from a minimum of 5 periods a week to 15 periods a week for one year. Student teachers teach very few classes, but they teach them continuously for a semester or a year. After many trials it has been found best to limit the student teachers to one or two subjects. To give a few sporadic lessons before a class is one thing; to teach a subject continuously is quite another matter.
4. Practice teaching must be under the continuous direct or indirect supervision of an experienced teacher who knows the school, the class, and the detailed progress

of the subject taught. Hence all supervising teachers at Brown University are selected from the experienced teachers of the schools. Each student teacher has one supervising teacher and each supervising teacher one student teacher. The work is strictly individual.

5. Practice teaching must be closely correlated with the university work. At Brown University supervising teachers are selected by the university and paid a small remuneration. Each student teacher is visited once a week by the professor in charge of the practice teaching and private conferences are held. He also meets once a week in a general conference all the student teachers. Plan books for the past week are presented and discussed and later returned to the student teachers. Student teachers are at the same time pursuing other courses (1) in education, a course in secondary education and a seminar in current educational problems, and (2) in departments allied with the subjects they are teaching.

Student teachers who teach more than five periods a week usually receive some remuneration for their work from the school. In the case of the city of Providence this is provided for by an agreement between the university and the city of Providence. In other cases it is arranged as the cases arise. Student teachers who have shown themselves efficient are assigned other classes under supervision. For this work they receive remuneration. The work then becomes closely similar to what is known as "part-time work" in vocational education.

Graduate students who are admitted to the practice teaching at Brown University usually have taken as undergraduates four semester courses in education. These courses are: History of education, principles of education, educational psychology, and general method. In the last course there is some systematic work in observation and some teaching of the class by members of the class; for this last purpose the class s divided into sections of about 10 each.

6. The last principle is one which is fundamental and appears in all of the work. Practice teaching must not be an injury to the school or to the pupil, but rather a benefit. Hence the student teacher is called upon freely to assist the supervising teacher or the principal of the school in doing a limited amount of clerical work, work with individual pupils, or other work which can be assigned with profit to the student teacher and to the school alike. The student teacher becomes to all intents and purposes a part of the school staff, subject to regulations as other teachers and working as the other teachers are in harmony with the general purposes and spirit of the school.[1]

UNIVERSITY OF CHICAGO.

By A. R. MEAD AND W. S. GRAY.

Practice teaching is a requirement for practically all persons who are candidates for a degree in education. This teaching is done, in most cases, in the University High School, an integral part of the School of Education. Some other teaching facilities are furnished by work in social settlements and private institutions. The University High School charges a tuition fee of $200 a year. It has a faculty of about 40 and an enrollment of about 400 children. In the high school the practice teaching is most thoroughly organized in mathematics, history, English, science, household arts, and home economics. The school furnishes practice teaching facilities in practically all subjects of the secondary curriculum. It is distinctly understood that this high school is to be used for experimentation, observation, and student teaching by the School of Education. The functions of this school and the effect of the work on its pupils are thus described:

> The University High School aims to perform a double function. For its pupils it seeks to provide the best possible opportunities for education during the secondary period. For the School of Education, or more broadly speaking, for the University

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[1] From School and Society, Vol. III, No. 67, pp. 533-535, Apr. 8, 1916.

of Chicago, it serves as a laboratory for the solution of educational problems. That there is no conflict between these aims the experience of the past nine years has made clear. That the practical demands of present education systems are not ignored is shown by the fact that during this time 570 graduates of the school have entered college or engineering schools. On the other hand, both in the general organization and administration of the school and in the matter and method of classroom instruction, the demands of the best educational thought and scientific advance have found expression. A school whose officers and teachers are students of the educational problems connected with their work is likely to furnish the most favorable conditions for the development and training of its pupils.—(High School Bulletin, 1913–14.)

The general administration of the work is shown by the following regulations:

GENERAL REGULATIONS.

Requirement for graduation.—Two majors of practice teaching completed with grades of C or better are required by the faculty in all undergraduate courses. Each major must include at least 50 hours of contact with the children in the classroom, laboratory, or field. During this time the student teacher must teach at least 15 lessons. This is a minimum requirement, however, and where it is possible to administer it the teaching of more lessons will be required. Ordinarily, practice teachers in the elementary school will teach from 30 to 40 lessons in each major.

Prerequisites for practice teaching.—The prerequisites for practice teaching in the high school are as follows:

1. General Introduction to Education. This course consists of a series of lectures, readings, and discussions introducing the students to the general problem of education and to the best sources of information and methods that lead to a scientific study of them. In addition to the work outlined above, the students make a large number of visits to schools in order to make a careful study of school organization and classroom practices. The results of these observations are written up and reported in class. In this way the inexperienced teacher secures a first broad outlook on problems of teaching.

2. Methods of Teaching in High Schools. This course is designed to introduce prospective high-school teachers to the specific problems which they will have to meet in connection with their future work. The course deals with such problems as the selection and arrangement of subject matter; the routine phases of school keeping; methods of learning involved in various school subjects, with corresponding methods of teaching; methods of securing interest and attention, of providing for individual differences, and of organizing supervised study; the use of textbooks and conversational methods; the planning and testing of teaching. In connection with the study of each of the foregoing topics, a series of classroom observations is carried on. The class and the instructor visit recitations in the University High School in order to secure concrete information concerning the problem under consideration. These observations are then made the basis for class discussions in the lessons which follow. Plan writing is emphasized. As nearly as possible, the student is introduced to all the general problems which underlie expert teaching.

3. A Special-Methods Course in the Subject to be Taught. The special-methods courses deal in a very specific way with the problems of teaching the respective subjects. In addition to the classroom work, directed observation has been introduced in order to bring the student in as close touch as possible with the work of the classroom. Directed observation is carried on in the special-methods classes in English as follows:

To each class in English in the University High School is assigned one student, a college senior, from the special-methods course. This student participates in the work of the high-school class in two ways: First, he is considered a member of the class in regular standing, being called upon to prepare the subject matter the class is considering, and called upon to recite upon that subject matter as is any other member of the class; second, the supervised observer becomes an apprentice, working in the actual teaching problems of the class under the personal direction of the high-school instructor. From time to time he is assigned duties, like the reading of a set of themes, the discussion of these themes in class, conducting part of a recitation on an assigned passage in literature. He is in consultation with the high-school instructor in the preparation of plans, and has unlimited opportunity to see the inside workings of classroom procedure.

4. A general average of "C" or better in all academic work is required in practice-teaching courses. Failure to use good oral and written English disqualifies students from continuation in practice-teaching courses. In all cases, applicants for practice-teaching privileges in the high school must have qualifications in the subject to be taught satisfactory to the department which is concerned in the College of Education.

THE CONDUCT OF PRACTICE TEACHING.

1. *General purpose and character.*—The purposes of this work are (*a*) to help students to appreciate educational theory by themselves putting it into practice, and (*b*) to train them in those practical adjustments which constitute effective teaching. Generally speaking, the sooner a student teacher can be prepared to do some effective teaching the better. Observation which follows some attempt at teaching is more valuable than that which precedes teaching.

2. *Duties of student teachers.*—(*a*) The student is responsible for understanding and appreciating the work of the quarter in the subject assigned for practice and any other phases of the curriculum of the school or the work of the grade that the critic teacher desires to take up.

(*b*) The student is responsible from the beginning for participating and assisting in the activities of the room, *e. g.*, correcting papers, gathering materials, assisting individual pupils, etc.

(*c*) As a rule the student will be assigned at first some easy subtopic in a larger unit and allowed to teach from one to five lessons, thus being initiated gradually into the work.

(*d*) The number of periods of teaching will be increased as the student becomes capable of assuming them.

(*e*) Student teachers are expected to attend critic meetings which are arranged by critic teachers. These will be frequent during the first part of the quarter.

(*f*) Student teachers should get ready to begin teaching as soon as possible, and are held strictly accountable for expected results.

(*g*) The student is primarily responsible to the critic teacher in whose place he teaches. He may be referred to the appropriate department in the College of Education for assistance in securing the material needed in preparation for his teaching. If the teaching is in the elementary school, the student is also responsible to the supervisor in whose group of grades he teaches.

3. *Reports by critic teachers.*—Reports are filed with the dean from the critic teacher. These reports will be made the basis not only for credits in the course but also for later recommendations to positions.

The points outlined below are considered in making these reports, which characterize very definitely and in detail the individuality of the student teacher. This does not mean that the critic teacher reports on each point in every case, but emphasizes those points that are especially significant for the particular student teacher concerned. The critic also adds comments on any other notable aspects of the student's work:

(1) Preparation of lessons.
(2) Skill in conducting recitation.
(3) Ability to manage children.
(4) Personal fitness for teaching.
(5) General rating of teacher.

4. *Departmental practices.*—In addition to the general regulations outlined above each department works out a series of suggestions and devices in regard to practice teaching. The following suggestions have been worked out by the mathematics department in the University High School:

(*a*) The student's work is of the following types: First, active teaching, including work with individuals who need special assistance; supervision of study classes, etc.; and second, routine work, such as calling the roll; collecting and distributing papers; reading and grading reports, examinations, etc.; supervising examinations; keeping records, etc.

(*b*) It is aimed to start the student in his work as soon as possible in order to give him the maximum amount of time for developing skill. If there is only one practice student in a class, that student may teach a part of each day; if there are several students, it is not possible to give daily opportunity to teach. The latter situation rarely arises.

(*c*) The first lesson taught is usually very short, about 10 minutes in length. It may be the development of a theorem or a formula. Method, aim, and the time limit are usually agreed upon beforehand by the student and critic teacher. After the lesson has been taught, the critic teacher meets the practice student to emphasize the strong and weak points of the student's teaching and to make constructive suggestions where help is needed.

(*d*) As teaching power develops the duration of the teaching periods is lengthened and the student's responsibilities are increased along all lines. As soon as the student shows sufficient power he is given charge of the class for the entire class period.

TEACHERS COLLEGE, COLUMBIA UNIVERSITY, TYPES OF PRACTICAL WORK.

By ROMIETT STEVENS.

Practical work in various forms has been carried on by Teachers College for many years, but the nature of the work has changed somewhat in recent years, owing to the different opportunities offered in the secondary field.

The types of practical work now recognized and for which credit is allowed in the various departments are the following: Supervised observation, supervised teaching, training in supervision, and experimental work.

I. SUPERVISED OBSERVATION.

The college has two schools of observation—the Horace Mann School for Boys and the Horace Mann School for Girls—which are always open to students of special method and general method for observation of the work of experienced teachers. In addition to these schools of observation the students visit the public and private schools in New York City and vicinity where almost every phase of educational work may be found.

II. SUPERVISED TEACHING.

Having no high school of its own for supervised teaching, the college is developing several different centers of activity for different types of practical work: One in the high schools of New York City; a second in a group of suburban communities near New York; a third in Y. M. C. A. schools, night schools, settlement classes, etc.

In the city high-school center one opportunity for practical work is offered through the New York City plan of using teachers-in-training in high schools. This privilege is open only to graduate students whose academic qualifications in their several subjects of major interest meet the requirements set by the city. Previous experience in teaching is not required, but eligibility is measured by an examination given by the board of education. Candidates must devote to the work at least half of each school day for one semester. A student may elect to do practical work during either or both semesters, the maximum credit for which is a half course each half year.

The second opportunity for practical work is offered by a system of supervised observation and teaching in New York City and vicinity. Graduate students, with or without experience, who seem to the official advisers entirely to be qualified to undertake work of this nature, may be recommended to school principals to do practical work.

The suburban group is composed of high schools in near-by towns that can be reached by ferry and trolley within 30 or 40 minutes. By arrangement made separately by the boards of education of Leonia, Cliffside, and Englewood, N. J., and the dean of Teachers College, college students in limited numbers are permitted to serve as apprentices to the regular teachers for periods of five weeks each, rendering such service to the teacher of class as the teacher directs. During the five-week period of service the time of the college students is divided substantially as follows:

First week: Observation of class teacher and pupils in order to become acquainted with individual pupils and to know them by name, to become familiar with the teacher's methods as well as the text-books in use, and to study the children in the class who require special treatment.

Second week: Generally some form of active participation in the work of the class hour is permitted, including the following phases of practical work: Correcting papers and holding conferences with the pupils for consideratiom of the same; tutoring pupils who for one reason or another need to make up ground lost; gathering and presenting illustrative material for class use—material that is available in the libraries and museums of Teachers College.

Third week: If the general attainment of the student teacher warrants it, there is some teaching, beginning with a portion of a class period, as, for example, telling a story in German (last 10 minutes of the hour); developing the new lesson; presenting a general topic in history; some phases of oral composition.

Fourth and fifth weeks: Teaching, under supervision of the teacher and the college supervisors. The teacher leaves the novice with the entire control of the class and the discipline for intervals of time, as soon as it seems wise to do so.

PREREQUISITES AND CREDIT FOR SUPERVISED TEACHING.

In the School of Education the degree of B. S. or B. A. from an accepted college is prerequisite; in the School of Practical Arts, practical work is given to seniors and to graduate students. The professor in charge of the subject of the student's major interest must also be satisfied, before recommending the student for practical work, that the candidate has had, or is taking, suitable work in the general field of education and in the content of the subject the student is preparing to teach. The student must register for one full course in special method, one-half course in general method, one-half course in supervised observation and practice, the equivalent of which is about 75 hours of the student's time per semester. The time is divided as follows:

Time spent in practical work, 1 hour per day for five weeks—25 hours.

Hours spent in observation in other schools or classrooms, some preceding and some following the period of student apprenticeship in the classroom—20 hours.

Conference hour with supervisors, 1 per week for all practice students, meeting together—15 hours.

Preparation, personal conferences, etc.—15 hours and upward.

All inexperienced students are required to do practical work in partial fulfillment of the requirements for a Teachers College diploma as teacher of a special subject. The student must, however, first satisfy the professor in charge of his major subject regarding his intellectual, physical, and social fitness for teaching before he is recommended for practical work. These recommendations are made to the professor who has charge of the administration and supervision of practical work. When a student is assigned to a school he reports to the principal who instructs him in necessary school standards and routine matters to enable him to fit into the school life without friction. The class teacher determines the nature of the practical work and the amount of actual teaching. If she finds the class work suffers in any way, through the presence of the teacher in training, she is at liberty to remove him, or to delay his teaching, or to change the nature of his work. The class teacher serves as adviser and friend.

Practice teachers are supervised by four different groups of experienced people; first, by the official group of college supervisors; second, by the principal of the school and the teachers, whose suggestions and criticisms are of inestimable value to the student teachers; third, by selected students of experience, who are candidates for diplomas as principals and inspectors of high schools; fourth, occasionally by professors in charge of the student's major subject—the subject that he is teaching.

In addition to this personal supervision, all practice teachers meet with the college supervisors for one hour every Friday afternoon in the semester for a general round-table conference. At intervals the student supervisors are called upon to offer criticism of the work of the student teachers, after which there is discussion of the nature of their supervision.

III. TRAINING IN SUPERVISION.

This field of practice is not yet fully developed but wherever practice teachers are at work there are excellent opportunities for training in the supervision of instruction. Each classroom may thus become a laboratory for two types of practical work. The pupils are in no way molested by the presence of a student supervisor, and the student teacher is benefited by having his work analyzed and criticized by some one from the practical field who is somewhat older than he in experience.

IV. EXPERIMENTAL WORK.

Occasional opportunities are offered for experimentation in adapting subject matter to the needs of particular groups of pupils and in trying out methods of presenting subject matter.

The Speyer School (formerly an elementary school for experimentation and practice belonging to Teachers College) reopened on February 1, 1916, as a city public school of junior high-school grade. Teachers College serves the school in an advisory capacity and is planning a series of experiments with the curriculum and with methods of teaching.

Harvard University.

By Romiett Stevens and Alexander Inglis.

I. PRELIMINARY STATEMENT.

At present, courses specifically designed to train secondary school teachers are offered to seniors and graduate students.

II. COURSES FOR THE TRAINING OF SECONDARY SCHOOL TEACHERS AT PRESENT OFFERED.

1. No student is admitted to apprentice courses in secondary school teaching unless he has taken the general course in the principles of secondary education. In addition he is supposed to have taken courses in (*a*) the principles of education, (*b*) the history of education, and (*c*) general and educational psychology. Further, he is required to present evidence that he has manifested sufficient knowledge of the subject or subjects which he intends to teach in the secondary school. He is admitted to the apprentice teaching course at the option of the instructor in charge of that course with due reference to his personality and other qualifications.

2. The course in the principles of secondary education is so organized that during the first half year those who are planning to enter the course in apprentice teaching make systematic observation of teaching and class management in the secondary schools in

the vicinity of the university. During the two months or one month before the close of the first semester that observation is made in the class which the student will conduct during the second semester.

3. The course in apprentice teaching comes in the second semester; the work of the course consists primarily of actual teaching in one of the secondary schools in the vicinity of the university, but the class meets twice a week as a whole for the discussion of problems and principles of classroom practice definitely connected with the student's experience in his practice teaching. Principles of method are considered in direct connection with practice, so that theory and practice may be closely related.

III. THE OPPORTUNITIES FOR OBSERVATION AND APPRENTICE TEACHING.

1. *Observation.*—Within easy reach of the university are more than 50 different high schools with more than 1,000 teachers and enrolling more than 20,000 secondary school pupils. These high schools are of various types. All are open to observation by the students of the university, and systematic observation is required of prospective secondary school teachers enrolled in the division of education.

2. *Apprentice teaching.*—At present contract agreements exist between the university and the school committees of nine cities within easy reach of the university. Apprentice teaching is provided for in those cities by these formal contracts. The cities thus affiliated with the university are Arlington, Belmont, Brookline, Cambridge, Lexington, Medford, Somerville, Newton, and Watertown. The aggregate population of those cities is about 350,000, the number of high schools 14, the number of teachers about 400, and the number of pupils in the secondary schools about 10,000. Thus ample opportunity is afforded for apprentice teaching in some of the best secondary schools of the country. Further, among the high schools involved are manual training high schools, vocational high schools, technical high schools, and junior high schools. Practically all high-school courses are to be found exemplified in those cities.

3. No "model" school is conducted under the auspices of the division of education. In any case it is probable that the apprentice teaching would by preference be confined largely to the public schools. The division emphasizes particularly the value of apprentice teaching under conditions as normal as possible. Further, no single secondary school of the size desirable for model schools could satisfactorily provide for all the students preparing for positions in the secondary school.

IV.—THE ADMINISTRATION OF THE APPRENTICE TEACHING.

1. In accordance with the agreements made between the university and the school committees of the cities mentioned, candidates are assigned to practice teaching positions in the various cities after conference with the school authorities who have the right to reject any candidate for satisfactory reasons.

2. The student assigned to a position in any school, after a period of partial control and responsibility, assumes full responsibility of a single class during the last half of the school year, always under the supervision and control of the teacher assigned for that purpose. His period of service lasts for about 18 weeks and the number of periods which he teaches varies from 3 to 5 per week according to the subject, etc. Thus his classroom experience normally varies from 54 to 90 school periods.

3. The supervision and direction of the work of the apprentice teacher is shared by the teacher assigned for that purpose (usually the head of the department in the school), the principal of the school, and the college instructor with his assistants. By far the greatest share of the supervision rests with the teacher who is constantly in charge of the student's teaching.

V. ADDITIONAL PROVISIONS FOR OBSERVATION AND TEACHING.

1. Arrangements have recently been made by the division of education with the Boston school committee whereby properly qualified students may act as assistants to teachers in the high schools of Boston, assuming partial responsibility for a given class.

THE SCHOOL OF EDUCATION, UNIVERSITY OF CALIFORNIA.[1]

The school of education at the University of California has a cooperative plan with the city of Oakland, which supplies facilities for practice teaching. The one school utilized is a six-year high school beginning its work at the seventh grade on the old plan of eight-four years in grades and high school. The university agrees to pay sufficient salaries to keep the per capita cost of the school down to that for the entire city system of Oakland.

The supervisory staff consists of a member of the faculty of the school of education, the principal of the high school, and eight head teachers who are also supervisors.

The prerequisite work in education includes the following: (1) History of modern education, or history of American education; (2) high-school administration, or principles of moral education; (3) school management (may parallel practice teaching).

The prospective practice teacher makes application for the work upon a blank like that following:

[Front of card.]

UNIVERSITY OF CALIFORNIA—SCHOOL OF EDUCATION.

APPLICATION FOR PRACTICE TEACHING—EDUCATION 201.

.... Semester, 191... -191....
Date of application ...., 191....
Name..
Residence teaching term.............. Phone.............
Year of graduation {December / May} 191.... Degree.............
Majors: 1. .... 2. .... 3. ....
Minors: 1. .... 2. .... 3. ...... 4. .....

Photograph must be in before assignment is made.

Courses in philosophy and education completed previous to teaching term: ....
....
Courses in education to be taken simultaneously with the practice teaching: ....
....
Other courses in education to be taken: ....
....

Teaching preferences:
1. .... 2. .... 3. .... 4. ....
School activities you could supervise:

[Back of card:]

WEEKLY PROGRAM FOR THIS TERM.

	8.00	9.00	10.00	11.00	1.00	2.00	3.00	4.00
Monday..................	......	......	......	......	......	......	......	......
Tuesday..................	......	......	......	......	......	......	......	......
Wednesday..................	......	......	......	......	......	......	......	......
Thursday..................	......	......	......	......	......	......	......	......
Friday..................	......	......	......	......	......	......	......	......
Saturday..................	......	......	......	......	......	......	......	......

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[1] Data furnished by Prof. W. W. Kemp and Prof. C. E. Pugh.

If possible, leave two consecutive, free hours between 9 and 3 o'clock throughout the week.

[To be filled in by the instructor:]

Assigned to..School.
Subject..................................hours...............room................
Began teaching............................... Finished teaching................
Grade in instruction.......................... Grade in discipline..............
Remarks:

The application having been filed, the previous record of the student is investigated. If satisfactory, he is assigned for observation and practice to one of the department heads in the high school. When ready to teach, he takes charge of the class for the balance of the semester.

The term "practice of teaching" is used to include lectures, readings, conferences, observation, and actual teaching. The total credit is 4 hours. At the university the work covers the following items: (1) Lectures and reports; (2) term plans setting forth the work to be accomplished; (3) lesson plans setting forth in detail the aims, subject matter, and methods of a particular lesson or lessons; (4) observations and reports on observations; (5) conferences on lessons taught by practice teacher and observed by the instructor; (6) final report on work accomplished and rating of pupils; (7) a final paper exhibiting the candidate's ability to set forth the theoretical and practical aspects of a particular educational problem. The work at the high school consists of observations, conferences with supervisory teachers, and actual teaching.

School of Education, Indiana University.

Indiana University, like Iowa State University, is located in a small city. The organization of the work in the two institutions contains certain similarities, which will be evident from the description of the work at Indiana.

Bloomington, Ind., the seat of Indiana University, is a small city of nearly 9,000 population. In most cities of this size the high school faces the persistent problem of securing high-grade teachers without adequate financial resources to pay salaries large enough to attract such teachers. At Bloomington, even before the plan was in use at Iowa State University, a cooperative plan had been evolved by which Indiana University school of education utilized the high school for laboratory purposes in teacher training and the high school was enabled to secure very high-grade teachers. In general, the plan provides that the head of a high-school department (e. g., English) is at the same time the instructor in special methods in his specialty in the school of education, and at the same time the supervisor (critic teacher) of practice teaching in that subject. It is believed that this plan of close cooperation originated at Indiana University.

All of the practice teaching is under the general supervision of the associate professor of secondary education. Before a student is assigned to teaching, he must have met the following prerequisites: (1) Completed courses in principles of education (3 hours), secondary education, including administration and principles of teaching (4 hours), special methods of the subject to be taught (2 hours); (2) must have college credits in the subject to be taught amounting to 20 semester hours; (3) the assignment must have the sanction of the collegiate department concerned (e. g., the department of English), the sanction of the general supervisor, and of the critic teacher. Presumably the sanction of the local superintendent of schools is implied, although he is represented in the critic teacher. By such a plan the schools are protected from poorly prepared apprentice or practice teachers. Content, theory, and judgments as to other phases of ability have been given consideration. Further, such a plan guarantees continuity in the training of the teacher. The same person who gives the course in special methods supervises the actual teaching. (University Catalogue, 1916–17.)

The student visits the class for several days before he is allowed to take charge of the class. Meanwhile the regular (critic) teacher is doing the teaching. When conditions are favorable according to the judgment of the critic teacher, the student takes actual charge of the class. The period of teaching is usually one semester. The number of periods taught per week is usually five. Thus an equivalent of five semester hours of practice work is given the teacher.

After the practice teacher has taken charge of the class the supervisor visits the class almost daily for the first few weeks. Later, fewer visits are made. "After every visit the practice teacher receives an oral or written criticism, or both. The critic supervises the teacher's plans and outlines and holds a general conference with his group once a week. Each teacher is officially rated by the critic three times a semester, the teacher having been made familiar with the standards used at the beginning of the term and the results of each rating being discussed after it is made. Additional ratings are made just before the close of the term by the high-school principal and the professor of secondary education at the university."

The cost of the cooperative plan consists primarily of salary expense.[1] The first year the supervisor is paid $1,500, and annually thereafter $100 additional to the maximum of $1,800. The city school system pays 60 per cent.[2]

TEACHERS COLLEGE, LOUISIANA STATE UNIVERSITY.

As a result of the endowment of a teachers' college at Louisiana State University through the final distribution of the Peabody fund, that institution has recently organized work for the professional training of high-school teachers. The organization includes a "Demonstration High School" on the campus and under the direct control of the teachers' college. Pupils are admitted to the eighth, ninth, tenth, and eleventh grades. Two fees, which total $10, are charged to pupils attending this school.

Though the school is named the Demonstration High School, it includes practice teaching. The prerequisite work for practice teaching is as follows: (1) 18 semester hours in a major subject and "12 semester hours in two allied minors;" (2) 6 hours of educational psychology; (3) 6 hours in high-school management and instruction; (4) observation of teaching with three; (5) 3 hours of special method given by a selected instructor in the regular academic department; after this work the student is admitted to practice teaching. About 2 semester hours of actual class teaching is done, and about 1 semester hour of observations and conferences parallel with the teaching. Each teacher keeps a detailed record of his work, which record is open to the inspection of the supervisory force.

The supervision of the teaching is exercised jointly by the dean of teachers' college, the professor of educational psychology, and the principal of the high school.

About 30 student teachers per year are completing this work of practice teaching. Interest in this type of work is increasing. It is not possible to give any careful estimate of the cost, because of the shortness of time during which the practice teaching has been in progress. The attitude of the pupils and the attitude of the patrons are very good toward the school.[2]

PRACTICE TEACHING AT THE UNIVERSITY OF MINNESOTA.

By RAYMOND A. KENT.

Practice teaching for students in the college of education was begun in the fall of 1908. The work was done in a six-year secondary school maintained by the college on the campus of the university.

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[1] Educational Monographs, Society of College Teachers of Education, No. VII, p. 41.

[2] Data furnished by Dean D. T. Powers.

In the fall of 1914 the work was reorganized. The university high school was moved into a new building especially provided and equipped for it and for the college of education. On account of limited funds, only the last four years of high-school work were continued.

THE UNIVERSITY HIGH SCHOOL.

Admission to the university high school is limited by the following conditions:

1. The applicant must not be over 20 years of age at the time of applying.
2. The applicant must not be a student at any other institution or in any other department of the university at the time when in attendance at the high school.
3. The applicant must present records of scholarship which show clearly that he has not done unsatisfactory work in another institution.
4. The applicant must present satisfactory credentials with respect to his character and previous conduct.
5. The university high school will not enroll more than 150 pupils at any one time during the year 1916–17.

In choosing the instructors for this high school a combination of three qualities is sought in each individual appointed. These qualities are:

First. Excellence of scholarship in the field which one's particular branch or branches represent.

Second. Excellence of method as a high-school teacher.

Third. Excellence in professional interest and ability. The individual must have shown the proper attitude toward the modern problems of education and must possess a high order of constructive critical ability of high-school teaching.

The college of education believes that a high school well organized, well taught, and well administered is a prime essential to practice teaching.

COOPERATION WITH CITY SCHOOLS.

A legislative enactment of 1913 and subsequent interpretation of the same by the State department of education requires every college and university graduate to pursue at least a semester of observation and practice teaching before being eligible to teach in any public school of Minnesota. This ruling resulted in a larger enrollment in practice teaching than could be assigned to such work in the university high school. Through the cordial cooperation of the Minneapolis public schools, arrangements were made whereby university students were assigned to practice teaching in the city schools. In 1914–15 this work was done in the various city high schools and to a limited extent in the seventh and eigth years in departmental class work. During 1915–16 the assignments have been limited to high schools, except in a very few cases, such for example as a beginning German class in an eighth grade.

1. *Prerequisites.*—The college of education believes that scholarship in the chosen field is the first essential to success in teaching. It therefore insists that no student in the university shall be allowed to enroll as a practice teacher, unless the department in whose field he wishes to teach recommends him.

In addition to scholarship, certain professional requirements are made. The ruling of the State department, above referred to, requires 12 semester hours of work in education in addition to practice teaching, and stipulates that at least 3 of these hours must consist of two courses in special method. The college insists that a special method course covering the subject which the student wishes to teach be pursued before the practice teaching is begun. Since students are seniors when they do practice teaching, and since the college requires 15 hours in education exclusive of general psychology, almost all have completed twelve hours in education, including general psychology, before practice teaching is begun.

2. *Content of course.*—What does the course entitled "Practice teaching" include in Minnesota? At least three things—(1) directed observation and (2) actual teaching (3) under supervision. For the present at least it seems highly advantageous for

students to spend from a week to 10 days or even two weeks in carefully directed, well-digested observation before they themselves begin to teach. The first lesson plans some make are the plans of the work in the recitations observed. The student begins teaching only after the critic is reasonably certain that the student has in mind clearly the object to be attained, and has presented a satisfactory plan of execution.

Again referring to the State ruling, it is supposed that each person, during the semester that he pursues the course in practice teaching, will conduct at least 36 recitations, or perform work equivalent thereto.

From the beginning there has been no real difficulty in supervising the work of the students practicing in the university high school. There is no high-school class not directly in charge of a regular high-school instructor. This instructor is in most cases the critic of the practice students working with her class. Personal interviews and group meetings, formal and informal, are easily arranged between the critic and her students.

The present plan gives to each critic in the university high school the supervision of all students doing practice teaching in her department, whether these students are assigned to the university high school or to city high schools. The critic visits each student as often as her time will permit. So far this task has not been so great but what each critic has been able to check the work of each student frequently and closely.

3. *Practice teachers' meetings.*—Supervision includes, besides visitation, group meetings held regularly. At these meetings the critic takes up with her students such matters as her judgment selects. In addition to the group critic meetings there are two general meetings of all practice teachers each month. Here are presented facts of general professional importance. Coherence, clarity, and lack of repetition throughout the work are gained through frequent conferences among the members of the faculty of the university high school.

4. *Checking results.*—The greatest weakness of methods and courses for training secondary school teachers up to date has been the failure to integrate this training with later actual practice. Standards, methods, and substance have been too far academically determined. The individual therefore found certain readjustments necessary when confronted by the actual problems of his later experience. Colleges of education stand in danger of becoming academic in training teachers for high school.

The college of education seeks to prevent this condition in three different ways:

First. It refuses to give a college grade in practice teaching to any one who for any reason shows that he can not teach high-school classes.

Second. The scale of rating by which practice teachers and practice teaching are to be judged is being made on the base of factors that appear during practice which count most for later success or failure. The scale of rating is by no means completed as yet. It is barely begun. Whether it will ever be so far completed as to stand without change is a question. It will approach completion only through several years of close study of the product which the college puts into teaching.

Third. This study will be accomplished through field checking. This checking has begun in a modest way. It seeks information from two sources—from the graduate of the college and from the supervisor of that graduate.

5. *Teaching assistants in public schools.*—The college of education in cooperation with the Minneapolis public schools has adopted a plan which provides for employing in the high schools a certain number of university graduates to be known as teaching assistants. The adoption of this plan is in essence the establishment in the Minneapolis public schools of a certain number of teching fellowships for graduate students. These teaching assistants receive compensation for their work in the school proportionate to the amount of time devoted to teaching; $300 for the first year, $400 for the second year.

For each assistant a definite couse, combining graduate professional study and teaching experience is outlined. Although the plan provides an abundance of teaching experience, the greater emphasis is thrown upon advanced professional training.

Teaching assistants are on duty at the schools from 8.30 until 12.15. Their work is divided between teaching and assisting. During their first year they do not instruct more than two classes per day, that is, one-third of a regular teacher's teaching period. If they continue a second year, the portion of their time devoted to class instruction may be increased to three periods per day. Their work as teaching assistants is limited to the hours during which they are on duty in the schools, and no additional work other than preparation for teaching their regular classes is required of them outside of the above set schedule of hours.[1]

UNIVERSITY OF MISSOURI.

By ROMIETT STEVENS and J. L. MERIAM.

The school of education maintains a high school which serves largely as a practice school and an elementary school which serves largely for observation purposes. The high school enrolls approximately 150 students each year. The elementary school is limited to approximately 100 pupils. The professor of school supervision in the school of education is superintendent of both these schools. The high school has a principal devoting his full time to administrative and supervisory work, also a lady associate principal whose work is largely supervisory, but administrative in being in immediate charge of the girls of the school. In addition to the supervisory work of the superintendent and these two principals, there are a number of so-called teaching supervisors, varying from year to year. These supervisors are usually graduate students with a successful public-school experience, academic training in their own special subjects, and professional training in the school of education. These supervisors spend approximately one-half their time in the interests of the high-school work. They do some regular teaching and supervise practice teachers in their own departments.

In the elementary school there are five regular teachers, including one who serves as principal. All of the teaching is done by these regular teachers.

The students in the school of education undertake practice teaching in their senior year. They are expected to have already had considerable academic work in their own subject, also professional courses in educational psychology, theory of teaching, and the teaching of their own subject. However, these courses are not strictly prerequisites, and many such students take these courses parallel with practice teaching. These practice teachers devote one hour each day throughout the year to the teaching of their own subject. Preparation for such practice teaching requires from one to two hours or more for each hour of class work. These practice teachers are under the immediate supervision of the teaching supervisors and the superintendent. A meeting of these teachers is held once each week for instruction on general methods of the school and problems which are of common interest. At this time also teaching supervisors meet their groups of teachers for special problems.

OHIO WESLEYAN UNIVERSITY.

By A. R. MEAD.

Education in this institution is the work of a department of a small college. The practice teaching done at this institution, as well as all work done in education, is in its beginning stages. At present all facilities for practice teaching are those of the subfreshmen classes. The following secondary subjects are included in this work: Latin (4 years); English (2 years); mathematics (3 years); physics (1 year); history (1 year); German (1 year). This group of students meets in college classrooms and has the use of all college facilities as other students.

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[1] School and Society, Vol. IV, No. 82, pp. 140-144, July 22, 1916.

5. *Elementary functions of a complex variable:* Simple algebraic functions; circular and logarithmic functions.

6. *Theory of analytic functions:* Properties of the integral $\int f(z)\,dz$. Series of Taylor and of Laurent. Poles, essentially singular points, residues. Reduction of the hyperelliptic integrals.

7. *Differential equations of the first order:* General solutions, particular solutions, singular solutions. Simple types of integrable equations. Integrating factor. Theorem of Briot and Bouquet on the existence of the solutions in the cases where the known functions are analytic.

8. *Differential equations and systems of equations of any order:* General solution, particular solutions, first solutions. Simple types of integrable equations. Linear equations.

9. *Integration of linear partial differential equations of the first order.*

10. *Integration of differential equations (partial or total) of the first order.*

MECHANICS.

11. *Statics:* Composition of forces applied at a point. Attraction of a spherical homogeneous shell at an exterior or interior point. Elementary properties of potential. Reduction of forces applied to a solid body. Conditions of equilibrium of a solid body. Applications to simple machines. Funicular polygon. Suspension bridges. Catenary. Principal of virtual work.

12. *Kinematics:* Velocity, acceleration. Movement of a plane figure in its plane. Representation of the movement by the rolling of a moving curve on a fixed curve. Movement of a solid body about a fixed point. Representation of the movement by the rolling of a moving cone on a fixed cone. Movement of a solid body in space. Helicoidal movement. Relative movements. Theorem of Coriolis.

13. *Dynamics of a particle:* Work. General theorems. First integrals of the equations of motion. Application to the motion of the planets. Movement of a point on a curve or on a surface. Pendulum in a vacuum and in a resisting medium. Conical pendulum. Geodetic lines.

14. *Geometry of masses:* Centers of gravity. Moments of inertia.

15. *Dynamics of systems:* General theorems. First integrals. Energy, stability of equilibrium. Movement of a solid body about a fixed axis. Pressure supported by the axis. Compound pendulum. Movement of a solid body about a fixed point. General movement of a solid body. Law of friction and slipping. Application of the principle of *vis viva* to machines. D'Alembert's principle. Lagrange's equations. Relative motion. Percussions.

16. *Canonical equations:* Jacobi's theorem.

17. *Hydrostatics:* Equilibrium of a fluid mass. Level surfaces. Pressure on a plane wall. Archimedes's principle. Equilibrium of floating bodies.

18. *Hydrodynamics:* General equations of motion of a fluid mass. Bernoulli's theorem. Torricelli's theorem.

LESSONS.[1]

Parts of the programs from which are drawn the subjects of the lessons.

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[1] Although the program of "Lessons" for 1914 is given on pp. 175–177 of the *Bulletin Administratif* mentioned above, the examinations on these lessons took place after the war had commenced, and I have been unable to find any published list of lesson-subjects selected at that time. As the program of lessons for 1910 and the corresponding list of lesson-subjects were available, they are given in this appendix. There is considerable variation in the program of "Lessons" from year to year.

MATHÉMATIQUES SPÉCIALES.

Series: Series of positive terms; character of convergence or divergence drawn from the study of the expressions: $\frac{u_{n-1}}{u_n}$, $\sqrt[n]{u_n}$, nu_n. Absolutely converging series. Convergence of series, with terms alternately positive and negative, of which the general term decreases constantly in absolute value and tends toward zero. Numerical examples.

General properties of algebraic equations: Number of roots of an equation. Relations between the coefficients and the roots. Every rational and symmetric function of the roots may be expressed rationally as a function of the coefficients. Elimination of one unknown between two equations by means of symmetric functions. Condition that an equation has equal roots. Study of the commensurable roots. Descartes's theorem. Complex numbers. De Moivre's theorem. Trigonometric resolution of the binomial equation.

Functions: Function of a real variable, graphic representation, continuity. Definition and continuity of the exponential function and of the logarithmic function. Limit of $\left(1+\frac{1}{m}\right)^m$ when m increases indefinitely in absolute value. Derivative of a function; slope of the curve represented. Derivative of a sum, of a product, of a quotient, of an integral power, of a function of a function. Derivative of a^x and of $\log x$. Use of logarithm tables and of the slide rule. Rolle's theorem, law of finite increments, graphic representation. Functions of several independent variables, partial derivatives. Law of finite increments. Derivative of a compound function. Derivative of an implicit function (admitting the existence of this derivative). Employment of the derivative for the study of the variation of a function; maxima and minima. Primitive functions of a given function, their representation by the area of a curve.

Functions defined by a power series with real coefficients. Interval of convergence: Addition and multiplication. In the interior of the interval of convergence one obtains the derivative or the primitive functions of the function, on taking the series of derivatives or of the primitive functions (functions which extend to the extremities of the interval are not considered). Examples: Developments in series of $\frac{1}{1-x}$, $\frac{1}{1+x^2}$, arctan$x$, $\log(1-x)$, $\log\frac{1-x}{1+x}$. Exponential series. Binomial series. The equations $y'=y$, and $y'(1+x)=my$ serve to determine the sum of the last two series. Development into series of a^x, of arcs in x.

Curves whose equation is resolved or resolvable with regard to one of the coordinates: Tracing. Equation of the tangent at a point; subtangent. Normal, subnormal. Concavity, convexity, points of inflexion. Asymptotes. Application to simple examples and in particular to the conics and to those curves of which the equation is of the second degree with respect to one of its coordinates.

Curves defined by the expression of the coordinates of one of their points as functions of a parameter: Tracing. Numerical examples. Curves of the second order and those of the third order with a double point are unicursal.

Curves defined by an implicit equation: Equation of the tangent and of the normal at a point. Tangents at the origin in the case where the origin is a simple point or a double point. Discussion of the asymptotes in the case of numerical examples of curves of the second and of the third order.

Curvature. Envelopes. Developables.

Polar coordinates: Their transformation into rectangular coordinates. Equation of a right line. Construction of curves; tangents, asymptotes. Applications (confined to the case when the equation is solved with respect to a radius vector). Case of the conics.

Gauche curves: Tangent. Osculating plane. Curvature. Applications to the circular helix.

Study of surfaces of the second degree with reduced equation: Condition of the contact of a plane with a surface. Simple problems relative to tangent planes. Normals. Properties of conjugate diameters. Theorems of Apollonius for the ellipsoid and the hyperboloids. Circular sections. Rectilinear generatrices. The surfaces of the second order are unicursal.

DYNAMICS.

1. *Free material point:* Principle of inertia. Definition of force and mass.[1] Relation between the mass and the weight. Invariability of the mass. Fundamental units. Derived units. Movement of a point under the action of a force, constant in magnitude and direction, or under the action of a force issuing from a fixed center: (1) Proportional to the distance; (2) in the ratio inversely as the square of the distance. Composition of forces applied at a material point.[2] Work of a force, work of the resultant of several forces, work of a force for a resulting displacement. Theory of living force. Level surfaces. Fields and lines of force. Kinetic energy and potential energy of a particle placed in a field of force.

2. *Material point, not free:* Movement of a heavy particle on an inclined plane, with and without friction, the initial velocity acting along the line of greatest inclination. Total pressure on the plane; reaction of the plane. Small oscillations of a simple pendulum without friction; isochronism.

DESCRIPTIVE GEOMETRY.

Intersection of surfaces: Two cones or cylinders, cone or cylinder and surface of revolution, two surfaces of revolution of which the axes are in the same plane.

II.—LESSONS ON THE SUBJECTS OF THE PROGRAMME OF THE SECONDE AND PREMIÈRE (C AND D) AND MATHÉMATIQUES A.

Seconde (C and D).

Algebra: Resolution of equations of the first degree in one unknown. Inequalities of the first degree. Resolution and discussion of two equations of the first degree in two unknowns. Problems; substitution in equation. Discussion of the results. Variation of the expression $ax+b$; graphic representation. Equations of the second degree in one unknown (theory of imaginaries not discussed). Relations between the coefficients and the roots. Existence and signs of the roots. Study of the trinomial of the second degree. Inequalities of the second degree. Problems of the second degree. Variation of the trinomial of the second degree. Graphic representation. Variation of the expression $\frac{ax+b}{a^1x+b^1}$; graphic representation. Notion of derivative; geometrical significance of the derivative. The sign of the derivative indicates the direction of the variation; applications to very simple numerical examples and in particular to the functions studied before.

Geometry: Simple notions of homothetic figures. Similar polygons. Sine, cosine, tangent, and cotangent of positive angles less than two right angles. Metrical relations in a right triangle and in any triangle. Proportional lines in the circle. Fourth proportional; mean proportional. Regular polygons. Inscription in a circle of a

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[1] It is admitted that a force applied at a material point is geometrically equal to the product of the mass of the point by the acceleration that it impresses on the point

[2] It is admitted that, if several forces act at a point, the acceleration that they impress on the point is the geometric sum of the accelerations that each of them impresses on it, if acting alone.

square, of a hexagon; of an equilateral triangle, of a decagon, of a quindecagon. Two regular polygons of the same number of sides are similar. Ratio of their perimeters. Length of an arc of a circle. Ratio of the circumference to the diameter. Calculation of π (confined to the method of the perimeters). Area of polygons; area of a circle. Measure of the area of a rectangle, of a parallelogram, of a triangle, of a trapezium, of any polygon. Ratio of the areas of two similar polygons. Area of a regular convex polygon. Area of a circle, of a sector, and of a segment of a circle. Ratio of the areas of two circles.

Première (C and D).

GEOMETRY.

Translation: Rotation about an axis. Symmetry with respect to a line. Symmetry with respect to a point. Symmetry with respect to a plane. This second kind of symmetry is equivalent to the first.

Trihedral angles: Disposition of the elements. Trihedral symmetry. Each face angle of a trihedral is less than the sum of the other two. Limits of the sum of the face angles of a trihedral. Supplementary trihedrals. Applications. Inequalities of the trihedrals.

Homology: Parallel plane sections of polyhedral angles. Area.

Polyhedra: Homothetic polyhedra, similar polyhedra. Prisms, pyramids. Summary of notions on the symmetry of the cube and of the regular octahedron. Volumes of parallelepipeds and of prisms. Volume of a pyramid. Volume of a pyramid truncated by parallel sections. Volume of a truncated triangular prism. Ratio of the volumes of two similar polyhedra. Two symmetrical polyhedra are equivalent. Sphere: Plane section, poles, tangent plane. Circumscribed cone and cylinder. Area and volume.

Mathématiques A.

Arithmetic: Common fractions. Reduction of a fraction to its simplest terms. Reduction of several fractions to a common denominator. Least common denominator. Operations with common fractions. Decimal numbers. Operations (considering the decimal fractions as particular cases of ordinary fractions). Calculation of a quotient to a given decimal approximation. Reduction of an ordinary fraction to a decimal fraction; condition of possibility. When the reduction is impossible, the ordinary fraction can be regarded as the limit of an unlimited periodic decimal fraction. Square of a whole number or of a fractional number; nature of the square of the sum of two numbers. The square of a fraction is never equal to a whole number. Definition and extraction of the square root of a whole number or of a fraction to a given decimal approximation. Definition of absolute error and of relative error. Determination of the upper limit of an error made in a sum, a difference, a product, a quotient, knowing the upper limits of the errors by which the given quantities are affected. Metric system.

Algebra: Monomials, polynomials; addition, subtraction, multiplication, and division of monomials and of polynomials. Equations of the second degree in one unknown. Simple equations which are equivalent. (The theory of imaginaries is not developed.) Problems of the first and second degree. Arithmetic progressions. Geometric progressions. Common logarithms. Compound interest, annuities.

Trigonometry: Circular functions. Addition and subtraction of arcs. Multiplication and division by 2. Resolution of triangles. Applications of trigonometry to various questions relative to the elevation of planes. (The construction of the trigonometric tables is not to be considered.)

Geometry: Inversion. Applications. Peaucellier's cell. Polar of a point with respect to a circle. Polar plane of a point with respect to a sphere. Hyperbola;

Trace, tangent, asymptotes; simple problems on tangents. Equation of a hyperbola with respect to its axes. Plane sections of a cone and of a cylinder of revolution.

Vectors: Projection of a vector on an axis; linear moment with respect to a point; moment with respect to an axis. Geometric sum of a system of vectors; resultant moment with respect to a point. Sum of the moments with prospect to an axis. Application to a couple of vectors.

Descriptive geometry: Rabatting. Change of plane of projection; rotation about an axis perpendicular to a plane of projection. Application to distances and angles; distance between two points, between a point and a line, between a point and a plane; the shortest distance between two lines of which one is vertical or at right angles to the plane, or of two lines parallel to the same plane of projection; common perpendicular to these lines. Angle between two lines; angle between a line and a plane; angle between two planes.

Kinematics: Units of length and of time. Motion. Relative motion. Trajectory of a point. Examples of motion. Rectilinear motion; uniform motion; velocity, its representation by a vector. Varied motion, mean velocity; velocity at a given instant, its representation by a vector; mean acceleration; acceleration at a given instant; its representation by a vector. Uniformly varied motion. Curvilinear motion. Mean velocity, velocity at a given instant defined as vectors. Algebraic value of velocity. Hodograph. Acceleration. Uniform circular motion, angular velocity; projection on a diameter. Simple oscillation in a line. Change of the system of comparison. Resultant of velocities. Examples and applications. (Purely geometrical applications are not to be insisted upon.) Geometrical study of the helix. Helicoidal motion of a body. Screw and nut.

Dynamics: Work of a force applied to a material point. Unit of work. Work of a constant force, of a variable force. Elementary work, total work. Graphical evaluation. Work of the resultant of several forces. Theorem of forces acting on a material point. Simple examples.

Cosmography: Moon. Apparent proper motion on the celestial sphere. Phases. Rotation. Variation of the apparent diameter. Eclipses of the moon and of the sun.

II. EXAMINATIONS IN THE CONCOURS.

(1) *Written*, 1914.

MATHÉMATIQUES ÉLÉMENTAIRES.

(June 30. Time, 7 hours: 7 a. m. to 2 p. m.)

Let A_1, A_2, A_3, A_4, be the four vertices of a tetrahedron T. Let $a_{i.j}$ represent the length of an edge A_iA_j and $O_{i.j}$ the middle point of this edge. Denote also by (A, B) the sphere described on any segment AB as diameter.

1. Calculate one of the geometric products [1] of two opposite edges of T as a function of the edges of the tetrahedron. Find the relation which exists between three of these products with respect to the three pairs of opposite edges.

2. Find the relation which must subsist between the lengths of the edges of T in order that the two lines $O_{1\cdot 2}O_{3\cdot 4}$ and $O_{1\cdot 3}O_{2\cdot 4}$ should be at right angles.

3. Suppose d is the distance between the radical planes of each of the spheres (A_1, A_2), (A_3, A_4) and of the sphere $(O_{1\cdot 2}, O_{3\cdot 4})$. Let d' and d'' be the analogous corresponding distances in connection with the two other pairs of opposite edges of the tetrahedron. It is required to find the relations which must subsist between the edges of the tetrahedron in order that $d=d'=d''$.

Three vertices of such a tetrahedron being given, find the geometric locus of the fourth vertex. Discuss.

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[1] It is recalled that the geometric product of two vectors $\overline{AB}$, $\overline{CD}$ is the product of the lengths of these vectors and of the cosine of the angle between them.

4. Being given any point M, draw the two bisectors of the angle A_iMA_j. Let $w_{i.j}$ be the middle of the segment cut by these bisectors on the line A_iA_j; there are six points $w_{i.j}$. Demonstrate that these six points are in the same plane π which may be associated with the point M. Conversely, any plane π being given, one may establish a correspondence of this kind with two points M and M' which are themselves associated. What position must be given to the plane π in order that the corresponding points M and M' fall together? How must the plane π be displaced when a corresponding point M describes a circle the plane of which passes through the center of the sphere circumscribed about the tetrahedron?

5. Given a tetrahedron T, construct a point M_0 coincident with its associate and situated at the same distance from the three vertices A_1, A_2, A_3.

Find the surface S, locus of the vertex A_4 when T is deformed, A_1, A_2, A_3 remaining fixed and the ratio $\frac{M_0A_4}{M_0A_1}$ preserving a constant value k.

Let D be any line passing through A_1. Construct the points of intersection of D and of S, and find the locus of the lines D tangent to S and the locus of the point of contact.[1]

MATHÉMATIQUES SPÉCIALES.

(July 1. Time, 7 hours: 7 a. m. to 2 p. m.)

Given a hyperboloid of one sheet whose equation, with respect to its axes, is $\frac{x^2}{\lambda^2}+\frac{y^2}{\mu^2}-\frac{z^2}{\rho^2}-1=0$.

I. There exist two families of such hyperboloids susceptible of being generated by the intersection of planes at right angles to one another passing respectively through two fixed lines; we may pass from a hyperboloid H of the first family to a hyperboloid H' of the second family by rotation through a right angle about Oz.

Let D, Δ be the fixed lines with respect to H; D', Δ' the fixed lines with respect to H'; find the surface loci of D, Δ and of D', Δ', when λ, μ, vary, ρ remaining fixed.

There exist planes P parallel to the plane xOy cutting these surfaces in two curves which have a common point A situated on Oz, and a common real point B situated in the trihedral $Oxyz$; evaluate the area bounded by the arcs AB of the two curves, also the volume generated by this area when the plane P has one coordinate (*cote*) varying from z_1 to z_2.

II. With a hyperboloid H_1 of the first family, a correspondence may be established with an infinite number of hyperboloids of the second family such that the fixed lines with respect to H_1 and the fixed lines with respect to one of these latter form a gauche quadrilateral; let H_2 be such a hyperboloid; D_1, Δ_1, and D_2, Δ_2 the fixed lines with reference to H_1 and H_2 respectively; $ABCD$ the quadrilateral formed by these lines; show that the hyperboloid H_3 generated by the intersection of two planes cutting at right angles and passing respectively through the diagonals of the quadrilateral $ABCD$ appertains to the linear point pencil defined by H_1 and H_2, that the feet a, b, c, d of the altitudes Aa, Bb, Cc, Dd of the tetrahedron $ABCD$ are on the curve of the pencil and that the lines, other than the altitudes, which join the points A, B, C, D to the points a, b, c, d are on a hyperboloid H_1, H_2, or H_3.

III. The hyperboloid H_1 being given, through a point A in space one may pass two hyperboloids H_2 of the second family defined as has been indicated (II); on what surface S must A be found in order that these hyperboloids H_2 coincide? So also through the point A one may pass two hyperboloids H_3 defined as in (II); on what surface S' must A be found in order that these hyperboloids H_3 coalesce?

Show that H_1 cuts S and S' along the same curve C, and that the intersection of S and S' is composed of the curve C and an imaginary curve.

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[1] These questions are solved in *Nouvelles Annales de Mathématiques*, tome 73, oct.-nov., 1914, pp. 491-505.

IV. Construct the projection Γ on the plane xOy of the curve C; show that Γ is the envelope of circles orthogonal to a fixed circle and find the locus of the centers of these circles.

Find the locus of the middle points of the chords of the curve Γ which passes through the origin.[1]

Composition on a Subject of Analysis.

(July 3. Time, 7 hours: 7 a. m. to 2 p. m.)

Being given three rectangular axes of coordinates $Oxyz$, consider the total differential equation (1) $a^2y^3dx+(z-a^2y^3)dy-ydz=0$ where a denotes a given constant.

I. Determine the surfaces that are solutions of the equation (1). These surfaces S are ruled; study their lines of striction and their asymptotic lines.

For each asymptotic line of a surface S, express the torsion as a function of the angle which the binormal makes with the axis Oz.

II. The surfaces S all satisfy a partial differential equation of the first order (E) independent of the numercial value of the constant a. Indicate how one may, by means of the surfaces S, generate all the surfaces Σ that are solutions of this equation.

The surfaces Σ contain in general the axis Ox; determine the exceptional surfaces which do not contain it and indicate their nature.

III. Demonstrate that the characteristic curves of the equation (E) are the asymptotic curves of the different surfaces S, and that they form one of the families of asymptotics of the surfaces Σ. Prove that they can be obtained as contact curves of the surfaces Σ with the right conoids having for axes the parallels to Oz meeting Ox.

IV. Determine the second family of asymptotic lines of the surfaces Σ. Prove that the curves of this second family can be obtained as curves of contact of the surfaces Σ with the right conoids having for axes the parallels to Ox meeting Oz.

Determine the ruled surfaces Σ which are distinct from the surfaces S. Indicate their nature.

V. Suppose T is a surface enjoying the property that one of its family of asymptotic lines is formed from the curves of contact of T with the right conoids having for axes the parallels to Ox meeting Oz. Prove that the surface T either is a ruled surface with director plane parallel to the plane yOz, or else satisfies a partial differential equation of the form (E') $F(z-qy,\ py)=0$, $\left(p=\frac{\partial z}{\partial x},\ q=\frac{\partial z}{\partial y}\right)$.

Show that in the second case the asymptotic lines of the other family are characteristics of the equation (E') satisfied by the surface T, and that these lines can be obtained as curves of contact of the surface T with the right conoids having for axes parallels to Oz meeting Ox.

If two surfaces, of which each satisfies an equation of the form (E'), are tangent in a point, they have at this point the same total curvature.[2]

Mechanics.

(July 4. Time, 7 hours: 7 a. m. to 2 p. m.)

Motion of a marble in a basin.

A homogeneous spherical marble is let go without initial velocity on the interior hemispherical surface of a fixed basin of which the axis of symmetry is vertical and which is concave upward.

Required to study the motion of the marble on the basin.

In particular solve the following questions concerning this motion:

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[1] These questions are solved in *Nouvelles Annales de Mathématiques*, tome 74, jan. 1915, pp. 15-20.

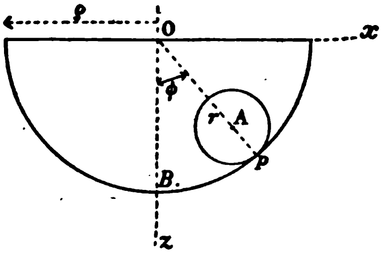
[2] Idem, tome 73, déc., 1914, pp.539-547.

I. Suppose first that the marble can be concentrated at a material point A.

1. Indicate the nature of its motion when the bodies in contact are perfectly smooth.

2. Consider then the case where the coefficient of friction f of the marble on the basin is not negligible. Determine first the condition of equilibrium for an initial determinate position A_0 of A. (Denote by ϕ_0 the initial value, comprised between 0 and $\frac{\pi}{2}$, of the angle ϕ of OA with the downward vertical OZ). When this condition is not satisfied, the point A is changed for a time in a determinate sense on a circle Γ. For the moment confine the calculation to that of the expression for the velocity v of A as a function of the angle ϕ during this interval of time T.

II. Then solve the same questions in the case where the radius r of the marble is not negligible.



But when the slipping friction is appreciable, confine the attention (neglecting the rolling friction) to the case where the marble rolls without slipping from the initial instant. Show that for a given initial position, A_0, of the center A of the marble this condition is necessarily produced if the coefficient of friction f is sufficiently large. (In this case call w the velocity of A, and Ω the instantaneous velocity of rotation of the marble.)

III. Find an approximate value of $\frac{w^2}{v^2}$, w and v being calculated for the same position of OA, very near to the common initial position OA_0 and for the same value of the coefficient f, when the radius r which enters in w^2 is very small.

IV. In a general manner, compare the results obtained in Paragraph I with those of Paragraph II when the radius r of the marble tends toward zero, and the values of ϕ_0 and of f (zero or not) remain the same. It is noted that these results are different; indicate in a few words the origin of this paradox.

V. Return to the case where the marble is reduced to a material point. Show that during the interval of time T the velocity v of the marble supposed rough is less than that, V, which it possesses if it were smooth when it passes through the same point, starting from the same initial position A_0.

VI. Then continue the study of the motion of the marble reduced to a material point and indicate the various circumstances which can present themselves according as the value of f and the position of A_0 (without now limiting ourselves to the case where the interval of time T when the velocity of A does not change the sense).

VII. In particular, indicate what happens when the value ϕ_0 is taken equal to 32°, then to 60°, the coefficient of friction having in the two cases the value 0.75, then the value $\frac{1}{2}$.

Notation: Call ρ the interior radius of the basin, O its center and mg the weight of the marble. It will possibly be found useful to set $\tan\theta=f$ and $\tan\theta'=2f$.

Of the candidates who took the previous examinations, 29 were declared by the jury to be *admissibles*. Further test of each of these by: (1) A numerical calculation; (2) a problem in descriptive geometry (*épure*); and (3) an oral "lesson" occurred on August 21, 1914. This resulted in the final selection of 15 agrégés.

The members of the jury for the entire examination were:

Niewenglowski, inspector general of public instruction, president.
Blutel, inspector general of public instruction, vice president.
Cartan, professor at the University of Paris.
Frechet, professor at the University of Poitiers.
Grévy, professor at Lycée St. Louis.

In 1910 the numerical calculation and épure were as follows:

NUMERICAL CALCULATION.

Calculate the integral

$$I=\int_0^{2\pi}\left(\frac{100-10\cos\alpha}{101-20\cos\alpha}\right)^2 d\alpha$$

The direct method of primitive functions should be employed and it should be compared with the results obtained by the methods of approximate integration. Indicate, in each of these methods, the number of significant figures that are determined with certainty.

DESCRIPTIVE GEOMETRY (ÉPURE).

A parabola P situated in a horizontal plane has for horizontal projection a parabola of which the focus is 96 mm. to the left of the major axis, and 60 mm. below the minor axis of the sheet; its vertex is 102 mm. to the left of the major axis and 54 mm. below the minor axis.

A frontal line D is inclined at 45° to the horizontal plane and it rises from right to left; it passes through the point of the horizontal plane of projection situated at 130 mm. to the right of the major axis and 96 mm. below the minor axis of the sheet. This line is met by the parabola P in a point situated to the right of the profile plane which contains the major axis of the sheet.

Consider the parabolic segment bounded by the arc of the parabola P which contains its vertex and by the parallel to the ground line distant 144 mm.; required to represent in vertical projection only the solid generated by the rotation of this segment about the line D.

Take the minor axis of the sheet for ground line.

SUBJECTS OF THE "LESSONS" IN 1910.

(1) *In Mathématiques Élémentaires.*

Solution of triangles.
Symmetry with respect to a point. }
Symmetry with respect to a line. } (As in the classe de première.)
Symmetry with respect to a plane. }
Variation of $\frac{ax+b}{a'x+b'}$; graphic representation (program of seconde).

Supplementary trihedral angles. Applications.
Rabattments. Applications.—Angle between two lines, angle between a line and a plane, angle between two planes.
Conversion of an ordinary fraction into a decimal fraction. Repeating fractions. (Mathématiques A.)
Volume of parallelepipeds and prisms. (Do not consider the truncated pyramid or the truncated prism.) (Première.)
Plane sections of a cone of revolution. (Dandelin's method.)
Homothetic polyhedra. Similar polyhedra. (Première.)
Relation between the coefficients and the roots of the equation of the second degree. Applications.
Summary of notions on the symmetries of the cube and of the regular octahedron.
Tangents to a hyperbola. Asymptotes. Simple problems on tangents.
Notion of the derivative, geometric significance of the derivative.
Application to the variation of simple functions. (Program of seconde.)
Homothety in plane geometry.
Inversion (in a plane and in space). Applications.
Motion of the moon. Phases.
Problems of the second degree. (Mathématiques A.)

(2) *In Mathématiques Spéciales.*

Small oscillations of a pendulum without friction: Isochronism.
Asymptotes in polar coordinates; position of the curve with respect to its asymptotes.
Theory of envelopes in plane geometry.
Normals to the ellipsoid.
Curvature of plane curves. Evolutes. Examples (rectilinear coordinates).
Motion of a point under the action of a force issuing from a fixed center and proportional to the distance.
Motion of a heavy particle on an inclined plane with or without friction, the initial velocity being zero or directed along the line of greatest slope.
Number e. Limit of $\left(1+\frac{1}{m}\right)^m$.
Series of positive terms. Criteria of convergence and divergence derived from study of the expressions:

$$\frac{u_{n+1}}{u_n},\ \sqrt[n]{u_n},\ nu_n^p;\ \text{numerical examples.}$$

Complex numbers. $a+bi$. Addition, subtraction, multiplication, division. Geometric representation.
Use of the derivative for the study of the variations of a function; maxima and minima. Numerical examples.
Developments into series. Applications to the series of the binomial and of arcs in x.
Motion of a point attracted by a fixed center in a ratio inversely as the square of the distance.
Construction of a curve ($\rho=f(\omega)$) in polar coordinates. (It should be assumed that the lessons on tangents and asymptotes have been given.)
Discussion of the commensurable roots of an equation with integral coefficients. Examples.
Multiplication of series. Applications.
Power series. Intervals of convergence. Differentiation. Integration.
Intersection of a surface of revolution and a cone.
Trigonometric solution of the binomial equation.
Infinite branches in the intersection of cones and cylinders. (Descriptive geometry)

Intersection of two surfaces of revolution of which the axes are in the same plane. Symmetric and rational functions of the roots of an algebraic equation.

The jury for the concours of the agrégation in 1910 consisted of:
Niewenglowski, inspector general of public instruction, president.
Hadamard, professor at the Collège de France, vice president.
Combette, inspector general of public instruction.
Grévy, professor at Lycée St. Louis.
Husson, professor at the university of Caen.

BIBLIOGRAPHY.

A mimeographed pamphlet (16 pp.) published annually from 1901 to 1913, by the Librairie Croville-Morant, Paris, contained the épreuves écrites and subjects of the "Lessons" for the Agrégation des Sciences Mathématiques of the year.

Published solutions of some of the questions of the agrégation during the four years 1910-1913 may be consulted in the following places:

Agrégation 1910.—Composition in Math. Élém.: *Journal de Math. Elem.*, année 35, mai, 1911, pp. 121-124; Composition in Math. Spéc.: (1) *Rev. de Math. Spéc.*, année 21, juin, 1911, pp. 214-221; (2) *Nouv. Annales de Math.*, tome 70, janvier, 1911, pp. 72-80; Composition in Analyse: *Nouv. Annales de Math.*, tome 70, janvier, 1911, pp. 21-39.

Agrégation 1911.—Composition in Math. Elém.: (1) *Journal de Math. Élém.*, année 36, juin, 1912, pp. 137-140; (2) *Nouv. Annales de Math.*, tome 70, août, 1911, pp. 358-373; Composition in Math. Spéc.: *Revue de Math. Spéc.* année 22, juin, 1912, pp. 512-518; épure: *Revue de Math. Spéc.*, année 22, août, 1912, pp. 576-578; Composition in Analyse: *Nouv. Annales de Math.*, tome 71, mai, 1912, pp. 231-240; Composition in mécanique: *Nouv. Annales de Math.*, tome 71, décembre, 1912, pp. 549-567.

Agrégation 1912.—Composition in Math. Elém.: (1) *Journal de Math. Elém.*, année 37, juin, 1913, pp. 149-154; (2) *Nouv. Annales de Math.*, tome 71, décembre, 1912, pp. 506-528; Composition in Math. Spéc.: *Revue de Math. Spéc.*, année 23, sept., 1913, pp. 289-294; Composition in Analyse: *Nouv. Annales de Math.*, tome 72, juli, 1913, pp. 316-323.

Agrégation 1913.—Composition in Math. Élém.: (1) *Jour. de Math. Élém.*, année 38, juin, 1914, pp. 141-144; (2) *Nouv. Annales de Math.*, tome 73, fév., 1914, pp. 81-89; Composition in Math. Spéc.: (1) *Revue de Math. Spéc.*, année 24, juli, 1914, pp. 553-558; (2) *Nouv. Annales de Math.*, tome 73, juli, 1914, pp. 316-324; Composition in Analyse: *Nouv. Annales de Math.*, tome 73, jan., 1914, pp. 26-34; épreuve pratique: *Revue de Math. Spéc.*, année 24, juli, 1914, pp. 559-561.

The programs for each year are usually published during the preceding July in the *Bulletin administratif du ministère de l'instruction publique.*

APPENDIX E.

GERMANY.

A. REIFEPRÜFUNGEN.

I. WURTTEMBERG.

Questions of a (1) Gymnasium; (2) Realgymnasium; (3) Oberrealschule.

(1) *GYMNASIUM:*

ALGEBRA AND TRIGONOMETRY.

1. Two places M and N are 119 km. apart; A goes from M to N and travels 20 km. on the first day, 18 on the second, etc., B starts from N toward M two days after A's departure and travels 10 km. on the first day, 13 km. on the second, etc. When and where do they meet each other?

2. Solve:

$$x-y=1-z.$$
$$x^2-y^2=\tfrac{7}{5}(1-z^2).$$
$$x^3-y^3=\tfrac{37}{7}(1-z^3).$$

3. A certain capital brought $4\frac{1}{2}$ per cent interest, and, although 420 marks were annually withdrawn, was doubled in 18 years. How large was the capital?

4. Solve the triangle given

$$a=450.34,\ \rho=92.45,\ \rho_a=367.52.$$

[ρ is the radius of the inscribed circle and ρ_a the radius of the escribed circle opposite the angle A.]

PLANE AND SOLID GEOMETRY.

1. Construct a triangle given h_a, t_a and the condition that the projection of t_a on a is equal to $b-c$. [h_a=altitude of triangle from angle A; t_a=length of the median from the angle A.]
2. On a given line segment a, draw two similar rectangles such that the portion of one outside the other is a square.
3. On a given line segment AB a semicircle is described. Find a point X on the diameter AB produced and a point Y on the tangent at A such that XY is divided by the semicircle into three equal parts.
4. A given rectangle $ABCD$ rotates about the side AB as axis. It is required to divide the rectangle into three parts by lines drawn from D such that the solids generated by these parts shall have equal volumes.

(2) *REALGYMNASIUM:*

HIGHER ANALYSIS.

1. Find the value of $\frac{(e^x-e^{-x})^2}{x\cos x}$, for $x=0$.

2. The total surface of a cylinder is 924 square meters. What must be its height and the length of the radius of its base in order that the cylinder should have a maximum volume?

3. For the curve $y=x^2(3-x)$ determine the maxima and minima points and point of inflexion, also the equation of the inflexional tangent. Graph the curve. Calculate the area between the curve and the positive $x-$axis.

4. Determine the area bounded by the curves:

$$y^2=-\tfrac{3}{2}(x-8) \text{ and } (x+4)\,(y+3)=36,$$

and lying within the first curve.

ANALYTIC GEOMETRY.

1. Through the vertices B_1 and B_2 of the minor axis of an ellipse and a focus F_1 a parabola is drawn whose axis coincides with the major axis of the ellipse. (*a*) Find the equation of the parabola; (*b*) Construct the tangents to the parabola at B_1 or B_2 and find their equations.
2. The tangent to the ellipse

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1.$$

at a point P meets the Y-axis in P_2; and the normal at P meets it in P_1. One focus F_1 is joined to P_1, the other to P_2. What is the geometric locus of the point of intersection of $F_1\,P_1$ and $F_1\,P_2$? (F_1 and F_2 on the X-axis.)

3. Consider whether or not the line $y=4x-2$, $z=3x+2$. Cuts the circle

$$x^2+y^2+z^2=30.$$
$$3x-5y+z+2=0.$$

4. Given a sphere with center at the origin and radius equal to 5. A cylindrical surface tangent to this sphere is described with generating line parallel to the line.

$$y=2x,\ z=3x.$$

Find the equation of the cylindrical surface.

(3) *OBERREALSCHULE.*

DESCRIPTIVE GEOMETRY.

A sphere is surrounded by a plane concentric ring (Saturn); the plane of the ring is parallel to the horizontal plane. Construct the shadow of the sphere on the ring, the shadow of the ring on the sphere; the shadow of the sphere on itself, the shadow of the whole system on the horizontal plane. (The light comes from above to the left and is parallel to the vertical plane.) The various measurements are supposed given.

TRIGONOMETRY.

1. In a place A, whose eastern longitude is $\lambda=9°\ 59'$, it was observed on the 19th of June that the sun rose at 24 minutes, 8 seconds past 4 (middle European time) and culminated at 48 minutes, 14 seconds past 5 (star time). Hence determine the geographical latitude of A, the M. E. T. of sunset, and the declination of the sun if the time equation is $+0'\ 24''$; and the inclination of the ecliptic is $\epsilon=27°\ 27'\ 10''$.
2. If $\alpha+\beta+\gamma+\delta=360°$, change the expression.

$$\cot\frac{\alpha}{2}+\cot\frac{\beta}{2}+\cot\frac{\gamma}{2}+\cot\frac{\delta}{2}$$

into a product in which δ is lacking.

PHYSICS.

(Mathematical questions only.)

1. A factory power canal 2 meters broad and 1 m. deep is closed by a heavy lock, of weight $G=110$ kg., and raised upward. How many horsepower must an electric motor possess in order to raise the gate entirely out of the water, in $t=3$ seconds, the coefficient of friction of the gate being $f=0.2$.
2. A plane convex lens stands centered opposite a telescope focused to infinity, and with its plane surface next the telescope. A luminous point lying on the other side of the lens, on its axis, is clearly seen in the telescope if it is at a distance $l=16.3$ from the vertex of the curved surface of the lens. What significance has l for the lens? How can the radius of curvature and the position of the principal points be calculated from this, if the thickness of the lens is $d=0.6$ cm. and the refraction quotient is 1.53?

II. HAMBURG.

(1) *WILHELM GYMNASIUM.* Spring, 1909.

1. An ellipse with semi-axes $a=7$, $b=5$ cm. is rotated about (*i*), the axis $2a$ (*ii*), the axis $2b$, and (*iii*), a tangent parallel to a. Compare the volumes of the three surfaces of revolution with one another.
2. Given the function $y=\log \frac{a+x^2}{2bx}$.

   Find the first and second derivatives, and the value of x for which the function is a minimum.
3. A square pyramid is to be circumscribed about a sphere of radius r, so that its volume shall be a minimum. What are the lengths of the edge of the pyramid and of a side of the square base?
4. How high is the sun on the longest day in Hamburg if it is exactly in the west and at what time (local time) does this occur?

Special exercises.[1]

1. $\int_0^8 - 4\sqrt[3]{x^2}dx=?$
2. Integrate $\int e^x . \sin x \, dx$.

(2) *REALGYMNASIUM.* Spring, 1907.

1. *Projective geometry:* The vertices A and A_1 of the major axis of an ellipse are joined to a vertex B of the minor axis; on these lines BA and BA_1, perpendiculars are let fall from the points D and D_1, in which a movable tangent to the ellipse cuts the tangents at the vertices A and A_1. Show that the locus of the point of intersection $\triangle$ of these perpendiculars is a hyperbola, of which the asymptotes are the perpendiculars through A and A_1 to BA and BA_1.
2. *Analytic geometry:* Given a hyperbola with center O and a line s perpendicular to the transverse axis and cutting it at a distance c from O; the polar of a point P_1 of s cuts the diameter $O\,P_1$ in $\triangle$. What is the locus of $\triangle$ as P_1 moves in s?
3. *Cubic equation:* In order to compare the specific heat of copper and lead one wants two quantities of equal superficial area and weight. If a quantity of lead in the form of a cylinder with ends capped by two hemispheres is available, then a similarly formed copper cylinder with hemispheres capping the ends must be

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[1] In practice, as a matter of fact, solutions of special exercises, which are very little harder than others, compensate for failure in one of the required questions. Two faultless solutions of questions are usually necessary and sufficient for the predicate "satisfactory." For "very good," four solutions without error are expected.

formed such that its weight $p=162\pi g$ and surface $O=27\ \pi$ cm.^{2} are equal to the piece of lead. Determine the height of the cylinder and the radius of the end hemispheres if the specific heat of copper is 9 *g cm.*$^{-3}$.

4. *Differential calculus:* The curve

$$yr^2=\frac{4}{3}\,x\,(r^2-\tfrac{1}{4}\,{}^2x^2)$$

has a point of inflexion, a maximum, and a minimum point. Determine these points and draw the curve.

Special exercises.

(*i*) Solve the first question by analytic geometry.
(*ii*) Solve the second question by pure geometry.

(*iii*) The intrinsic equation of Van der Waals is

$$R\Theta=\left(p+\frac{a}{v^2}\right)(v-b)$$

where p is constant and the absolute temperature Θ is a function of the volume v. For what value of v has the corresponding curve an inflexional tangent? What value must p have in order that the inflexional tangent be parallel to the axis of volume?

(3) *OBERREALSCHULE* (one of four), spring, 1907.

1. Through a payment of 6,000 marks a man 30 years of age purchases life insurance. How much is this insurance on the basis of 4 per cent interest and Schubert's table of vital statistics? What age must the man reach in order that an equal sum would be paid to his heirs from a savings bank in which the 6,000 marks at 3½ per cent had been deposited till the termination of the contract?
2. What regular spherical polygons can be made up of equilateral triangles and how large are the radii of the inner and outer tangent circles of these polygons?
3. Find the first polar of the curve

$$2x^3+2x^2-8x-y+8=0$$

with respect to the origin. Draw the curve and discuss it. Find its intersections with the x-axis and the tangents to the curve in these points.

4. What is the value of the difference

$$\int_{\frac{\pi}{4}}^{\frac{\pi}{3}}\frac{2\ \sin x\ -\ \sin 2x}{\cos x}dx-\int_{\frac{\pi}{3}}^{\frac{\pi}{2}}\frac{\cos x-\tan\pi/4}{\sin x}\,dx$$

Special exercises.

(*a*) Find the locus of the vertex of a triangle with given base 2 c and sides of given product p^2?

(1) What is the form of this locus according as p is greater than, equal to, or less than c?

Example for sketching: $c=3$

$p_1=2\sqrt{2},\ p_2=\sqrt{10},\ p_3=3$

(2) In what case is there a double point, and what are the tangents at this double point?

(3) Find the first polars of the point at infinity on the base of the triangle, of the point at infinity on the perpendicular bisector of the base, and also of the middle of the base with respect to the locus in question. Indicate the significance of these lines for the locus, and draw a sketch for the numerical values $c=3$ and $p=2\sqrt{2}$.

(*b*) Evaluate the integral

$$\int_{b:c}^{(b+\sqrt{b^2+ac}):c} \frac{dx}{\sqrt{a+2\,bx-cx^2}}$$

B. LEHRAMTSPRÜFUNGEN.

WURTTEMBERG.

I. Questions in the Mathematics-Physics Division.

HIGHER ALGEBRA.

1. Given the equation

$$x^4+a_1x^3+a_2x^2+a_3x+a_4=0$$

whose roots are all different from one another. Find the equation of the fourth degree in y, which is satisfied by the unsymmetric functions of roots $y=x_1+x_2+x_3$, etc. Prove that the discriminants of the two equations are identical.

2. According to the general interpolation formula find an integral algebraic function y_x (fourth order in x), which for

takes on the values $\begin{array}{l} x=0,\ 2,\ 3,\ \ \ 6,\ \ \ 9, \\ y=0,\ 0,\ 3, 105,\ 630 \end{array}$

(Indicate also a second method, without details; evaluate the determinants which here enter.) Further show that the value y_x can be changed into an "Überzweizahl," if for numbers of the form $\binom{n}{r}$ the name "Über-*r*-Zahl" is employed. Write down the values of the numbers y_{-1} to y_9. Further calculation of y_x checked by these values; calculation of the sum y_{-1} to y_x. Checks.

HIGHER ANALYSIS.

1. Evaluate and give the geometric meaning of the double integral

$$\int_0^{2a} \sqrt{\frac{2a-x}{4a-x}}\,dx \int_0^{\sqrt{x(4a-x)}} [\sqrt{x(4a-x)}-y]\,dy;$$

give a plan and elevation sketch.

2. $y=x\left[\frac{dy}{dx}-\left(1-\left(\frac{dy}{dx}\right)^2\right)\right]^{\frac{1}{2}}$.

3. $12xy^2\frac{\partial z}{\partial x}+3y(x^2-2y^2)\frac{\partial z}{\partial y}=2.$

4. Derivation of the properties of the logarithm and of the exponential function in the complex field. Give three examples.

ANALYTIC GEOMETRY.

1. Discuss the curve

$$x^5-x^4y-2x^3y^2+2x^2y^3+xy^4-y^5-2x^4+4x^3y-4xy^3+2y^4-4x^2y+3xy^2-y^3=0.$$

2. Find the equation of the tangent-surface of the space curve $x=\lambda$, $y=\lambda^2$, $z=\lambda^3$ and determine the orthogonal trajectories of the tangents on the surface. Without calculation, what may be stated with regard to the lines of curvature, the asymptotic lines, and the geodetic lines of the surface? (If time is lacking it is only necessary to write the differential equation of the trajectories.)

SYNTHETIC GEOMETRY.

1. Determine the center of a hyperbola given four points and the direction of an asymptote.

2. To four planes through a point O, no three of which cut in a straight line, the normals in O are given. How may the normal at O to any plane through O be con-

structed through simply joining and intersection, and in particular without the further use of a right angle?

Descriptive Geometry.

In a vertical plane of projection a semi-ellipse is given, of which the shadow is a semicircle. It is subjected to a rotation in space about a vertical axis. Construct the normal curve and the meridian of the surface of rotation so constructed, i. e., the section of any plane (1) perpendicular to the axis of rotation or (2) through the axis. (Suppose the proportions given.) Give a free drawing in india ink of the two curves sought, also a short description of the corresponding construction.

Analytic Mechanics.

1. On three mutually perpendicular weightless sticks, rigidly fastened together at a point O, "mass-points" P, Q, R are placed at distances a, b, c from O.

The system is turned about an axis through O which at a given instant, when the angular velocity is ω, makes angles α, β, γ with the three sticks.

How great is the *vis viva* of the turning motion of the system at this instant? Through what single force at O and what pair of forces (what axis-moment) may the three centrifugal forces be replaced?

Discussion of the results for the case $\alpha=\beta=\gamma$.

2. The velocities of three noncollinear points of a rigid body moving with freedom of the first order, are given for a certain instant as vectors, i. e., in size and direction. Show how to find, either by drawing or by calculation, for the same instant: (*a*) the velocity of a fourth point of the body, also considered as a vector, and (*b*) the central axis or rotation axis, i. e., the locus of the points of the body which, for the instant, of all of its points has the least velocity.

Trigonometry and Mathematical Geography.

1. On two points A and B of equal height and 25 meters from each other rests a smooth thin band of steel which sags 50 centimeters in the middle. How many millimeters (to the nearest tenth of a millimeter) is the band longer than 25 meters?

The calculation is to be carried through, and the exactitude of the result proved, without employing any tables. (The calculation is to be carried through in numbers.)

2. On a simple rod standard a vertical reference-plane F is determined by a strong white endless thread passing through two rings O_1 and O_2, and stretched with the help of a hanging stone O_3. The azimuth of the two directions of the thread differs by exactly 180°. The azimuth is not exactly known, but it corresponds about (according to the compass within 5°) to the prime vertical.

At the point of observation (in middle Germany), determining the northern latitude ϕ on an evening toward the end of November, 1895, the following times of transit through the plane of the thread are observed in siderial time:

γ Lyra (about westward) $S_1=22^h\ 29^m\ 59^s$,
γ Andromeda (about eastward) $S_2=22^h\ 35^m\ 45^s$.

The apparent AR [right ascension] and δ [declination] of the two stars on the evening of observation were:

γ Lyra $\alpha_1=18^h\ 55^m\ 2^s$, $\delta_1=+32^\circ\ 32'.8$,
γ Andromeda $\alpha_2=1^h\ 57^m\ 32^s$, $\delta_2=+41^\circ\ 50'.1$.

What is the northern latitude of the place of observation? What was the azimuth of the plane of the thread? What kind of stars are to be chosen for such determination of the northern latitude by transits through one and the same vertical first eastward and then westward? Calculation of ϕ in numbers is desired.

(The candidate is allowed a logarithm table.)

THEORETICAL PHYSICS.

1. Discussion of the physical foundations of the Newtonian definition of the quantities "force" and "mass."

2. Derivation of the formula of an adiabatic curve.

3. Foundations of a theory of plane diffraction grating for parallel light rays.

4. How and with what exceptions is Helmholtz's law of induction derived on the basis of the law concerning the conservation of energy?

II. Mathematical Questions of the Chemistry-biology Division.

ALGEBRA AND LOWER ANALYSIS.

1. A merchant buys wares for a certain sum, has in addition 5 per cent expenses, and sells them again for 504 marks, and thereby gains a twentieth part of the purchasing price. What did this amount to?

2. *A* left a fortune of 100,000 marks. From this his children must receive 6,810 marks annually for 10 years from the first payment within a year after his death. The capital after 10 years is to be devoted to school purposes. How large will this amount be?

3. Express the fraction $\frac{218}{299}$ as the sum of two positive fractions with denominators 13 and 23. What are possible solutions?

4. In the equation $x^4-11x^3+px^2+qx-60=0$ the root $2+i$ is given. Find the other roots and the coefficients p and q. (Check by means of Horner's method).

DIFFERENTIAL AND INTEGRAL CALCULUS.

1. $\lim\limits_{x=0}\frac{(e^x-e^{\sin x})}{(x-\sin x)}=?$

2. Express $y=\log(x+\sqrt{1+x^2})$ as a power series in x and discuss the convergence of the series.

3. Given the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}-1=0.$

Through the origin and with different points of the hyperbola as centers, circles are described. Find the equation of the envelope of these circles.

ELEMENTARY GEOMETRY.

1. Describe a circle which touches a given line in a given point P and cuts a given circle K at the ends of a diameter. (Analysis, construction, proof.)

2. Given a point and two lines L and L', which cut one another in A. On L find a point X such that the perpendicular XY from X on L' is a mean proportion between AY and PX. (Construction and proof.)

3. Given a right circular cone of which an axial section is an equilateral triangle. Produce the surface beyond the circular base, such that the whole surface of the added conical shell is to the surface of the whole cone as 5 is to 6 (including construction of the calculated result).

4. B and C are the middle points of two spheres of radii r_1 and r_2 (10 and 14 cm.). To an observer at A the spheres appear under angles of sight S_1 and S_2 (3° 37′ 20″ and 4° 16′ 30″). Angle BAC is 71° 4′ 40″. How great is the distance between B and C, and how large are the angles ABC and ACB?

ANALYTIC GEOMETRY.

1. The curve with equation

$$x^3-2x^2y+2y^3-y^2x-4y^2+2xy-x+2y=0$$

breaks up into three lines, of which one is $x-2y$. What are the equations of the other two? What are the coordinates of the vertices of the corresponding triangle; find its area.

2. In the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}-1=0$ a diameter with slope μ is given. What is understood by a diameter conjugate to this diameter and how is the slope μ' of this diameter derived? How large are the semi-diameters corresponding to these two directions?

3. Discuss and sketch the curve with equation

$$x^3+y^2x-2x^2+y^2=0.$$

4. Given a circle of radius r and a line which is at a distance a from the middle point of the circle. A second circle touches the line in its intersection with the line drawn through the middle point of the first circle perpendicular to the line; the common tangents of the circles touch the second circle in points, the locus of which is required. (The given line is to be taken as $x-$axis, and the foot of the perpendicular as origin of coordinates.)

DESCRIPTIVE GEOMETRY.

An ellipse is projected horizontally as a circle of 10 cm. diameter, vertically as a line (30° toward the right with the base line). The horizontal trace of a given plane makes an angle of 60°, the vertical trace of 45°, both toward the right with the base line. Construct the shadows of the ellipse on these planes. (Both projections of rays of light coming from the left make angles of 45° with the base line.)

The two projections of the shadows are to be constructed independently of one another; at any given point construct the tangent and find the nature of the curve in order that its conjugate diameters can be determined.

EXPERIMENTAL PHYSICS.

1. A locomotive weighing 20,000 kilograms moves on a track $1\frac{9}{16}$ meters wide and its center of gravity is $1\frac{1}{3}$ meters above the rails: what is the greatest velocity that the locomotive may attain in order that, on a curve of 80 meters radius, it shall not leave the rails? What is the maximum velocity, if the outer rail be so raised that the plane of the rails is inclined to the horizontal plane with an angle of 5°?

2. For determining the temperature of a smelting furnace, a platinum sphere of 100 grams is put in it and then thrown into a mixing calorimeter which contains 800 grams of water at 10° C. What is the temperature of the furnace if the brass calorimeter tub weighed 250 grams and the final temperature reached 14.8°? (Specific heat of brass, 0.0926; of platinum, 0.0326.)

3. Two biconvex lenses with focal lengths $f_1=4$cm. and $f_2=6$cm. are arranged from left to right, such that the distance of their optical middle point amounts to $\delta=1$ cm.; the thickness of the lenses may be neglected. To the left of the first lens is a luminous substance AB 1 cm. high. Construct the picture of the object which is thrown through the pair of lenses and also determine the distance b_1 of the picture from the second lens. How great is the common focal distance f of the system of lenses counted from the second lens; and what advantage is there in such a combination of lenses over a simple lens with the same focal distance?

APPENDIX F.

JAPAN.

The following mathematical papers were set in Tokyo for the twenty-fifth examination for teachers' licenses, in 1911.

PRELIMINARY EXAMINATION QUESTIONS.

ARITHMETIC (3 hours).

1. Find three fractions, A, B, and C equal to $\frac{3}{5}$, $\frac{4}{9}$, and $\frac{6}{11}$, respectively, such that A's denominator is equal to B's numerator, and B's denominator to C's numerator. Find the simplest forms of such three fractions.

2. A certain company, dividing its capital in the ratio of 3 : 5 : 7, carried on its business in three divisions. At a semiannual settlement it was found that the first division had made 2,600 yen, and the second had earned 8 per cent a year on its capital, but that the third had suffered a loss of 5 per cent a year of its capital. However, the net result was found to be a gain of 6 per cent a year on the total capital. What was the amount of the capital?

3. A steamer, bound for a certain port, had its engine damaged when one-fifth of its voyage had been completed. As it had to reduce its speed by 10 knots for the rest of its course, the average speed was found to be less than the first by 4 knots. What was the initial speed?

4. By evaporating 600 grams of water containing 3 per cent of salt, one containing 5 per cent of salt was to be obtained. It was found, however, that 70 per cent of the water had already evaporated. How much water containing 3 per cent of salt must be added in order to obtain the solution of required strength?

5. Of a cylindrical vessel holding one *shō*, the height and diameter of which are equal, find the height to the hundredth place.

ALGEBRA (3 hours).

1. When $a+b+c=0$, prove

$$\left(\frac{b-c}{a}+\frac{c-a}{b}+\frac{a-b}{c}\right)\left(\frac{a}{b-c}+\frac{b}{c-a}+\frac{c}{a-b}\right)=9.$$

2. Solve and discuss the following simultaneous equations:

$$ax-by-z+1=0, \qquad x+y-az-b=0, \qquad x+y-z+1=0.$$

3. Cut a triangle and a rectangle, having equal bases on a straight line, by another straight line [parallel to it] [1] so that the sum of the areas cut out between the parallel lines shall be equal to the area of the triangle. Find the distance between the parallel lines.

4. In how many different ways can 10 balls be arranged in a straight line, provided that 2 special balls must in all cases be placed so as to occupy alternate positions? [2]

5. Let a_1, a_2, a_3, ... be an arithmetic progression, and b_1, b_2, b_3, ... be a geometric having all its terms positive. Prove that a_n is not greater than b_n, if $a_1=b_1$ and $a_2=b_2$.

---

[1] These words do not occur in the original.

[2] It is not clear what is meant by "alternate positions."

GEOMETRY (3 hours).

1. Let two circles touch internally at A. From any point P in the circumference of the external circle draw a tangent $P\,M$ to the internal one, and prove that $P\,A:P\,M$ is constant.

2. Given a vertical angle, the radius of the inscribed circle, and the area, construct the triangle.

3. The vertex A of the rectangle $ABCD$ is a fixed point, and B and D are on the circumference of a fixed circle. Find the locus of the point C.

4. Find the limit of the position of a point, the ratio of whose distances from two fixed points is less than a given ratio.

5. Of a quadrilateral whose four vertices are not all in one plane, three are fixed and one moves along a straight line. Find the locus of the intersection of the lines joining the middle points of its opposite sides.

FINAL EXAMINATION QUESTIONS.

ARITHMETIC, ALGEBRA, AND GEOMETRY (written).

Part I (3 hours).

1. The sum of a certain irreducible fraction and its reciprocal is equal to $\frac{138794}{400115}$. Find the irreducible fraction.

2. Eliminate x, y, and z from

$$\frac{x}{a}+\frac{a}{x}=\frac{y}{b}+\frac{b}{y}=\frac{z}{c}+\frac{c}{z},$$

$$xyz=abc,$$

$$x^3+y^3+2(ab+bc+ca)=0.$$

3. If a, b, p, and q be real, prove that the following equation has real roots,

$$\frac{p^2}{a+x}+\frac{q^2}{b+x}-1=0.$$

4. Solve the following inequality, $x-b>\sqrt{a(a-2x)}$, where a and b are positive, and $\sqrt{}$ represents the positive square root.

5. Prove that the following three equalities are consistent with one another,

$$x=10^{\frac{1}{1-\log z}}. \qquad y=10^{\frac{1}{1-\log x}}, \qquad z=10^{\frac{1}{1-\log y}},$$

log representing the common logarithm.

Part II (3 hours).

1. If rectangles $ABDE$, $ACFG$ be externally constructed on the two sides AB and AC of the right angle A of a right-angled triangle ABC, prove that the straight lines BF and CD intersect with each other on the perpendicular from A to the hypotenuse BC.

2. Draw a circle with its center on a straight line passing through the center of a given circle, intersecting this circle at right angles and passing through a given point.

3. Of a triangle ABC, the vertex A is a fixed point on an edge of a trihedral angle and the other two vertices B and C move respectively along two other edges. Find the locus of the center of gravity of the triangle.

ARITHMETIC (oral).

A boat is rowed over a certain distance, when there is no tide, in 24 hours. With the tide, however, the same distance can be rowed over in 15 hours. Against the tide the boat can be made to go over 32 knots[1] in 2 hours. Find the speed, accordingly, when it is rowed with the tide.

ALGEBRA (oral).

Solve the following simultaneous equations,

$$(1+2k)\,x-(1+k)y=1-k,$$

$$3\,(1+k)\,x-(3+k)y=3+k.$$

GEOMETRY (oral).

Draw a straight line meeting two straight lines not in the same plane and normal to a given plane.

TRIGONOMETRY (written).

Theory (3 hours).

1. Solve and discuss the following equation,

$$\sin 3x=m\sin x.$$

2. Eliminate θ and φ from

$$c\sin\theta=a\sin(\theta+\varphi),$$

$$a\sin\varphi=b\sin\theta,$$

$$\cos\theta-\cos\varphi=2m.$$

3. Find the maximum value of

$$\frac{\operatorname{cosec}^2\theta-\tan^2\theta.}{\cot^2\theta+\tan^2\theta-1}$$

4. If the length of three bisectors of the three angles, A, B, C of a triangle ABC be respectively equal to p, q, r, prove that

$$\frac{\cos\frac{A}{2}}{p}+\frac{\cos\frac{B}{2}}{q}+\frac{\cos\frac{C}{2}}{r}=\frac{1}{a}+\frac{1}{b}+\frac{1}{c}$$

5. Having given one angle, the perimeter, and the radius of the circumscribed circle of a triangle; solve the triangle.

Application (3 hours).

When the three sides of a triangle are known to be respectively,

$a=750.74$ m., $b=596.42$ m., $c=204.68$ m.,

compute the three angles and the area.

ANALYTIC GEOMETRY (3 hours).

1. Given a point (1, 1) and a straight line $3x+4y-6=0$, the axes being rectangular. Form the equation of the curve of the second degree, having the point and the straight line for its corresponding focus and directrix and 5 for its eccentricity, and reduce it to the standard form.

---

[1] Such is the original.

2. Let N be the point of intersection of the normal at any point M on an ellipse and its major axis. Prove that the orthogonal projection of MN on the line passing through M and one of the foci is constant.

3. Prove that the four vertices of a parallelogram circumscribing an ellipse and its two foci are on the same equilateral hyperbola.

4. Given an ellipse and a circle concentric with each other, the radius of the circle being equal to the sum of half the major axis and half the minor axis of the ellipse. Prove that the locus of the point of intersection of the two normals to the ellipse at the points at which two tangents are drawn to the ellipse from any point on the circle is a circle.

5. Let N be the point of contact at which a tangent is drawn from the center M of a fixed circle to the circumscribed circle of a triangle self-conjugate with respect to the fixed circle. Prove that MN is constant.

DIFFERENTIAL AND INTEGRAL CALCULUS (4 hours).

1. If $f'(x).\ \varphi(x)-f(x).\ \varphi'(x)\neq 0$ within the interval $a \leqq x \leqq b$, and $f(a)=0$, $f(b)=0$, then prove that $\varphi(x)$ will become zero within the given interval at least once. Here $f'(x)$ and $\varphi'(x)$ are continuous within the given limits.

2. Let Y be the point at which the line passing through any point X on the diagonal AC of a parallelogram $ABCD$ and the vertex B intersects the side AD or its extension. Find the minimum of the sum of the areas of the two triangles AXY and BXC.

3. Take z as the function of two independent variables x and y; substitute

$$x=r \sin\theta \cos\varphi, \qquad y=r \sin\theta \sin\varphi,^{1} \qquad z=r\cos\theta$$

in $\sqrt{1+\left(\frac{dz}{dx}\right)^2+\left(\frac{dz}{dy}\right)^2}$; taking θ and φ as independent variables eliminate x, y, z.

4. $B(l, m)$ represents $\int_0^1 x^{-1}(1-x)^{m-1}\,dx$, l and m being positive.

Prove that

$$B(l,m)=\frac{l+m}{l}B(l+1,m).$$

5. Find the whole length of the space curve represented by the equations

$$ax=z\,(b+z), \qquad a^2(x^2+y^2)=b^2 z^2,$$

a and b being positive.

6. Take $x=\varphi(u,v)$ and $y=\theta(u,v)$, and change the variables of integration in

$$\int\!\!\int dxdy \text{ from } x,y \text{ to } u,v.$$

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[1] In the report this equation is given as $y=r \sin\phi$.

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BULLETIN, 1917, No. 28

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JUNE, 1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

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DEPARTMENT OF THE INTERIOR
BUREAU OF EDUCATION

BULLETIN, 1917, No. 32

REPORT ON THE WORK OF THE BUREAU OF EDUCATION FOR THE NATIVES OF ALASKA, 1915-16

WASHINGTON
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1917

except for 25 county superintendents in Mississippi and 4 in Idaho, where the State departments of education were unable to give salaries, for 122 probate judges serving ex officio as county superintendents in Texas, and for the rural superintendents in Connecticut. In Connecticut there are 35 supervising agents whose supervisory districts include 94 towns and whose salaries are paid directly from the State treasury. In regard to the salaries, Mr. Hine, secretary of the State board of education, says:

> Each supervisor must pay his own expenses from the specified salary which he receives. It follows that his net salary is dependent upon his territory and the number of schools and his method of traveling. His specified salary is not his actual salary. The net salaries of these men do not average more than $1,500 or $1,600. * * *. We have no desire to withhold the salaries of our agents, but it is impossible to give figures which will be correct and tell exactly or even approximately what the actual salaries are.

The salaries for city superintendent were collected directly from the cities. It was intended to get the salary paid in every city of 2,500 population or over employing a superintendent; 2,134 are given in the tables under the heading "cities." This is 89 per cent of the total number. However, a higher per cent is actually included. A considerable number of New England towns and cities with a population somewhat greater than 2,500 are in union districts; the salaries paid, therefore, are not given in the tables under those of city superintendents. Included under the salaries paid city superintendents are amounts paid in 19 cities in Maryland, 24 cities in Florida, and 20 cities in Louisiana; these salaries are actually for supervising principals, as the city schools in these States are under the management of the county boards of education and the supervision of the county superintendents. Three of the salaries given for Delaware are also for supervising principals.

The division made for this tabulation between "rural" and "city" superintendents in New England is more or less arbitrary. Under "city" are included the salaries paid to superintendents whose supervisory district is a single city or town. Under "rural" are included the salaries paid to superintendents of union supervisory districts made up of two or more towns. Rhode Island has only two union districts. It has 13 towns in which the so-called superintendents are members of the school boards receiving from $50 to $300; these are not included in the averages. Similar salaries paid in New Hampshire and Maine are not included.

Table 1 is a summary giving the average salaries paid for rural superintendents and city superintendents in each of the States and for the United States as a whole. The table gives also the number of superintendents whose salaries are used in computing the averages. It will be noted that 3,087 rural superintendents received an average of $1,375, while 2,134 city superintendents received an average salary of $2,260. The average county superintendent's salary is 61 per cent of the average city superintendent's salary. In three States the average rural superintendent's salary is greater than the average city superintendent's salary; these are Maryland, New Jersey, and Pennsylvania. As already stated, the Maryland city superintendents (with the exception of Baltimore city) are in reality supervising principals and are under the county superintendents. The New Jersey county superintendents all receive $3,000 a year, which makes the average paid higher than in any other State. Pennsylvania pays several county superintendents unusually high salaries, and the average paid to city superintendents is low on account of the large number of small cities which have superintendents or supervising principals.

The greatest actual difference between the average city superintendent's salary and the average rural superintendent's salary is in Montana, with Wyoming second. The average city superintendent's salary in Montana is $1,681 greater than the average county superintendent's salary, while in Wyoming it is $1,654 greater. Wyoming's county superintendent's salary is unusually low, lower in fact than in any other State.

In Table 2 is given a list of the States, arranged in order, according to the average salary of the rural superintendents, and again according to the average salary paid to city superintendents.

TABLE 1.—*Average salaries of superintendents.*

States.	Rural.		City.	
	Number.	Average salary.	Number.	Average salary.
Alabama	67	$1,543	28	$1,851
Arizona	14	1,600	12	2,567
Arkansas	23	1,424	25	1,849
California	57	1,771	66	2,722
Colorado	63	1,254	27	2,656
Connecticut	....	....	46	2,403
Delaware	3	1,200	4	2,025
District of Columbia	....	....	1	6,000
Florida	52	1,522	[1] 24	[1] 1,848
Georgia	152	1,041	40	2,212
Idaho	33	1,197	12	2,449
Illinois	102	1,907	143	2,239
Indiana	92	1,449	73	2,542
Iowa	99	1,546	71	2,211
Kansas	105	1,061	52	2,047
Kentucky	120	944	39	1,964
Louisiana	64	1,711	[1] 22	[1] 1,951
Maine	84	1,393	10	2,140
Maryland	23	2,187	[1] 20	[1] 1,687
Massachusetts	62	1,775	105	2,609
Michigan	83	1,253	74	2,572
Minnesota	86	1,476	48	2,575
Mississippi	56	1,551	28	1,962
Missouri	114	1,023	61	1,996
Montana	41	1,355	14	3,036
Nebraska	93	1,284	26	2,226
Nevada	5	2,000	8	2,488
New Hampshire	32	1,918	8	2,519
New Jersey	21	3,000	92	2,832
New Mexico	25	1,663	10	1,946
New York	207	1,352	147	2,465
North Carolina	100	1,140	31	1,785
North Dakota	52	1,643	13	2,537

[1] Supervising principals. Florida, Louisiana, and Maryland city schools are under the county superintendents.

TABLE 1.—*Average salary of superintendents*—Continued.

States.	Rural.		City.	
	Number.	Average salary.	Number.	Average salary.
Ohio	88	$2,041	133	$2,344
Oklahoma	77	1,348	44	1,922
Oregon	35	1,253	19	2,205
Pennsylvania	66	2,645	235	2,005
Rhode Island	[1] 4	1,600	19	2,137
South Carolina	44	986	20	1,853
South Dakota	60	1,214	11	2,587
Tennessee	96	864	29	1,787
Texas	129	1,439	62	2,261
Utah	32	1,465	15	2,458
Vermont	54	1,586	12	2,133
Virginia	86	1,290	20	2,155
Washington	40	1,117	28	2,551
West Virginia	54	1,052	27	1,944
Wisconsin	71	1,254	73	2,229
Wyoming	21	717	7	2,371
United States	3,087	1,375	2,134	2,260

[1] Does not include 13 members of school boards serving part time as superintendents.

TABLE 2.—*States arranged in descending order according to average salaries of superintendents.*

State.	Average salary of rural superintendent.	State.	Average salary of city superintendent.
New Jersey	$3,000	New Jersey	$2,832
Pennsylvania	2,645	California	2,722
Maryland	2,187	Colorado	2,656
Ohio	2,041	Massachusetts	2,609
Nevada	2,000	South Dakota	2,587
California	1,982	Minnesota	2,575
New Hampshire	1,918	Michigan	2,572
Illinois	1,907	Arizona	2,567
Massachusetts	1,775	Washington	2,551
Louisiana	1,711	Indiana	2,542
New Mexico	1,663	North Dakota	2,537
North Dakota	1,643	New Hampshire	2,519
Arizona	1,600	Nevada	2,488
Rhode Island	1,600	New York	2,465
Vermont	1,586	Utah	2,458
Mississippi	1,551	Idaho	2,449
Iowa	1,546	Connecticut	2,403
Alabama	1,543	Wyoming	2,371
Florida	1,522	Ohio	2,344
Minnesota	1,476	Texas	2,261
Utah	1,465	Illinois	2,239
Indiana	1,449	Wisconsin	2,229
Texas	1,439	Nebraska	2,226
Arkansas	1,424	Georgia	2,212
Maine	1,393	Iowa	2,211
Montana	1,355	Oregon	2,205
New York	1,352	Virginia	2,155
Oklahoma	1,348	Maine	2,140
Virginia	1,290	Rhode Island	2,137
Nebraska	1,284	Vermont	2,133
Colorado	1,254	Kansas	2,047
Wisconsin	1,254	Delaware	2,025
Michigan	1,253	Pennsylvania	2,005
Oregon	1,253	Missouri	1,996
South Dakota	1,214	Kentucky	1,964
Delaware	1,200	Mississippi	1,962
Idaho	1,197	Louisiana	1,951
North Carolina	1,140	New Mexico	1,946
Washington	1,117	West Virginia	1,944
Kansas	1,061	Oklahoma	1,922
West Virginia	1,052	South Carolina	1,853
Georgia	1,041	Alabama	1,851
Missouri	1,023	Arkansas	1,849
South Carolina	986	Florida	1,848
Kentucky	944	Tennessee	1,787
Tennessee	864	North Carolina	1,785
Wyoming	717	Maryland	1,687
Montana	3,036		

Further discrepancy between the salaries of county and city superintendents is given in Table 3. It includes from one to six counties in 37 States selected at random from the counties which include one city employing a superintendent. The name of the county and of the city is given, the population of each, and the salaries paid the two superintendents.

TABLE 3.—*Salaries of county superintendents and of superintendents of cities in the same counties, with population of county and city.*

State and county.	Population of territory under county superintendent.	Salary of county superintendent.	City.	Population of city.	Salary of city superintendent.
Alabama:					
Calhoun	17,321	$2,324	Anniston	12,794	$2,100
Dallas	39,752	2,400	Selma	13,649	2,700
Etowah	28,652	1,500	Gadsden	10,557	2,000
Jefferson	93,791	5,000	Birmingham	132,685	4,200
Mobile	29,333	2,100	Mobile	51,521	3,300
Montgomery	44,042	[1] 1,800	Montgomery	38,136	3,000
Arizona:					
Maricopa	23,354	2,400	Phoenix	11,134	4,000
Pima	9,625	1,500	Tucson	13,193	3,000
Santa Cruz	3,252	900	Nogales	3,514	2,500
Yavapai	10,904	2,000	Prescott	5,092	2,400
Arkansas:					
Garland	12,837	1,400	Hot Springs	14,434	3,000
Jefferson	37,632	2,400	Pine Bluff	15,102	3,000
Sebastian	28,303	1,600	Fort Smith	23,975	3,200
California:					
Butte	15,526	2,000	Chico	11,775	2,900
Fresno	50,765	2,700	Fresno	24,892	4,000
Kings	11,401	1,800	Hanford	4,829	2,500
Orange	24,000	2,250	Santa Anna	8,429	3,000
Riverside	19,484	2,400	Riverside	15,212	3,000
Sacramento	23,110	3,000	Sacramento	44,696	3,600
Colorado:					
Boulder	20,791	2,000	Boulder	9,539	2,500
Chaffee	3,197	1,500	Salida	4,425	2,000
El Paso	14,243	2,800	Colorado Springs	29,078	3,750
Lake	3,092	1,100	Leadville	7,508	2,100
La Plata	6,126	900	Durango	4,686	2,500
Logan	6,505	1,500	Sterling	3,044	3,000
Delaware:					
New Castle	35,777	1,200	Wilmington	87,411	4,500
Georgia:					
Baldwin	13,969	1,150	Milledgeville	4,385	3,000
Bartow	21,321	1,000	Cartersville	4,067	1,800
Ben Hill	6,068	900	Fitzgerald	5,795	1,800
Clarke	8,360	1,032	Athens	14,913	2,400
Cobb	22,448	900	Marietta	5,949	1,800
Coweta	23,252	1,000	Newnan	5,548	2,400
Idaho:					
Ada	17,730	1,500	Boise	17,358	3,300
Bannock	10,132	1,500	Pocatello	9,110	3,000
Latah	15,148	1,300	Moscow	3,670	2,000
Nez Perce	18,823	1,260	Lewiston	6,043	2,750
Washington	8,501	1,100	Weiser	2,600	2,100
Illinois:					
Alexander	8,193	1,500	Cairo	14,548	2,250
Boone	8,228	1,500	Belvidere	7,253	2,400
Cass	11,265	1,500	Beardstown	6,107	2,100
Champaign	30,408	2,250	Champaign	12,421	2,500
Coles	17,058	2,000	Mattoon	11,459	2,400
Dewitt	13,741	1,500	Clinton	5,165	2,200
Indiana:					
Bartholomew	16,000	1,408	Columbus	8,813	2,400
Cass	17,310	1,408	Logansport	19,050	2,500
Delaware	27,409	1,408	Muncie	24,005	3,000
Fayette	6,677	1,408	Connersville	7,738	2,200
Grant	32,167	1,408	Marion	19,359	2,500
Shelby	17,302	1,408	Shelbyville	9,500	2,500

[1] Increased to $5,000 Oct. 1, 1917.

TABLE 3.—*Salaries of county superintendents and of superintendents of cities in the same counties, with population of county and city*—Continued.

State and county.	Population of territory under county superintendent.	Salary of county superintendent.	City.	Population of city.	Salary of city superintendent.
Iowa:					
Blackhawk	18,172	$2,000	Waterloo	26,693	$5,500
Boone	17,279	1,500	Boone	10,347	2,400
Cerro Gordo	13,781	2,000	Mason City	11,230	2,600
Clinton	19,817	1,600	Clinton	25,577	3,000
Johnson	15,824	1,500	Iowa City	10,091	2,500
Linn	27,909	2,250	Cedar Rapids	32,811	3,500
Kansas:					
Atchison	11,678	1,200	Atchison	16,429	2,000
Bourbon	13,544	1,200	Fort Scott	10,463	2,200
Douglas	12,350	1,200	Lawrence	12,374	2,500
Labette	18,960	1,200	Parsons	12,463	2,000
Leavenworth	21,844	1,200	Leavenworth	19,363	3,000
Reno	21,489	1,200	Hutchinson	16,364	2,500
Kentucky:					
Campbell	29,060	1,000	Newport	30,309	2,500
Daviess	25,009	1,500	Owensboro	16,011	2,520
Fayette	12,715	1,800	Lexington	35,000	2,800
Franklin	10,670	1,200	Frankfort	10,465	2,000
McCracken	12,304	1,000	Paducah	22,760	2,500
Michigan:					
Alpena	7,259	1,000	Alpena	12,706	1,800
Calhoun	31,371	2,000	Battle Creek	25,267	3,500
Chippewa	11,857	1,500	Sault Sainte Marie	12,615	2,600
Delta	16,914	1,200	Escanaba	13,194	2,800
Manistee	14,307	1,000	Manistee	12,301	2,200
Muskegon	16,515	1,200	Muskegon	24,062	4,000
Minnesota:					
Blue Earth	18,972	2,282	Mankato	10,365	2,300
Mower	15,680	1,725	Austin	6,960	2,500
Rice	16,910	1,800	Faribault	9,001	2,500
St. Louis	84,808	2,500	Duluth	78,466	2,000
Washington	15,815	800	Stillwater	10,198	2,300
Winona	14,815	1,800	Winona	18,583	2,500
Mississippi:					
Adams	13,474	1,560	Natchez	11,791	2,250
Forrest	8,989	1,800	Hattiesburg	11,733	2,400
Hinds	42,464	1,800	Jackson	21,262	3,000
Lauderdale	23,634	1,800	Meridian	23,285	3,250
Missouri:					
Butler	13,708	1,100	Poplar Bluff	6,916	2,400
Cole	10,107	1,300	Jefferson City	11,850	2,300
Greene	28,630	1,500	Springfield	35,201	3,200
Marion	12,231	1,200	Hannibal	18,341	2,700
Pettis	16,091	1,400	Sedalia	17,822	2,400
Randolph	15,259	1,100	Moberly	10,923	2,250
Montana:					
Cascade	14,885	1,500	Great Falls	13,948	4,000
Custer	9,426	1,500	Miles City	4,697	2,800
Deerlodge	2,854	1,500	Anaconda	10,134	3,200
Lewis and Clark	9,338	1,500	Helena	12,515	4,000
Missoula	10,727	1,500	Missoula	12,869	3,000
Yellowstone	12,913	1,500	Billings	10,031	3,200
Nebraska:					
Adams	12,913	1,600	Hastings	9,338	2,700
Dodge	14,028	1,800	Fremont	8,117	3,000
Gage	20,969	1,800	Beatrice	9,356	2,400
Hall	10,035	1,600	Grand Island	10,326	2,200
Lancaster	29,820	2,200	Lincoln	43,973	4,000
New Jersey:					
Atlantic	25,744	3,000	Atlantic City	46,150	4,250
Camden	47,491	3,000	Camden	94,538	3,750
Mercer	28,842	3,000	Trenton	96,815	4,000
Union	66,788	3,000	Elizabeth	73,409	4,250
Warren	29,284	3,000	Phillipsburg	13,903	2,500
New Mexico:					
Bernalillo	12,586	2,000	Albuquerque	11,020	2,500
Chaves	10,678	2,000	Roswell	6,172	2,400
Luna	2,049	1,800	Deming	1,864	2,400
San Miguel	19,175	2,000	Las Vegas	3,755	2,000
Santa Fe	9,698	1,800	Santa Fe	5,072	2,000
North Carolina:					
Buncombe	31,036	1,800	Asheville	18,762	2,400
Craven	15,633	1,800	Newbern	9,961	2,200
Mecklenburg	33,017	2,000	Charlotte	34,014	2,650
Rowan	30,368	1,620	Salisbury	7,153	1,800
Wake	44,011	2,400	Raleigh	19,218	2,500
Wayne	29,591	1,500	Goldsboro	6,107	1,800

TABLE 3.—*Salaries of county superintendents and of superintendents of cities in the same counties, with population of county and city*—Continued.

State and county.	Population of territory under county superintendent.	Salary of county superintendent.	City.	Population of city.	Salary of city superintendent.
North Dakota:					
Burleigh	7,644	$1,700	Bismarck	5,443	$2,400
Cass	19,604	2,000	Fargo	14,331	3,600
Grand Forks	15,410	2,000	Grand Forks	12,478	4,000
Ramsey	10,042	1,800	Devils Lake	5,157	2,300
Ward	19,093	2,000	Minot	6,188	2,500
Ohio:					
Allen	30,508	2,500	Lima	30,508	3,000
Butler	34,992	2,500	Hamilton	35,279	3,400
Erie	18,338	2,716	Sandusky	19,989	2,900
Knox	57,841	1,800	Knoxville	36,346	3,000
Stark	72,770	3,500	Canton	50,217	3,500
Washington	29,409	1,800	Marietta	16,013	2,300
Oklahoma:					
Carter	16,740	1,400	Ardmore	8,618	2,600
Garfield	19,251	1,600	Enid City	13,799	2,100
Grady	19,980	1,600	Chickaska	10,320	2,100
Logan	20,086	1,600	Guthrie	11,654	2,000
Pittsburg	34,696	1,800	McAlester	12,954	2,400
Pottawatomie	31,121	1,800	Shawnee	12,474	2,400
Oregon:					
Baker	11,334	1,500	Baker	6,742	2,400
Clatsop	7,507	1,200	Astoria	8,599	2,100
Coos	14,979	1,200	Marshfield	2,980	2,200
Jackson	16,919	1,800	Medford	8,840	2,250
Lane	24,774	1.500	Eugene	9,009	2,400
Marion	25,686	1,500	Salem	14,094	2,250
Pennsylvania:					
Berks	87,151	4,000	Reading	96,071	4,000
Blair	56,731	2,000	Altoona	52,127	3,400
Butler	51,961	2,250	Butler	20,728	3,500
Dauphin	71,966	2,000	Harrisburg	64,186	3,500
Delaware	79,369	3,500	Chester	38,537	3,500
Erie	48,992	2,500	Erie	66,525	4,000
South Carolina:					
Charleston	29,761	1,500	Charleston	58,833	2,500
Greenville	52,636	1,200	Greenville	15,741	2,700
Richland	28,824	1,800	Columbia	26,319	2,500
Spartanburg	65,948	1,200	Spartanburg	17,517	2,200
South Dakota:					
Brown	15,114	1,500	Aberdeen	10,753	3,610
Codington	7,082	1,500	Watertown	7,010	2,400
Lawrence	11,302	1,500	Lead City	8,392	3,200
Minnehaha	15,537	1,500	Sioux Falls	14,094	3,500
Yankton	9,348	1,500	Yankton	3,787	2,000
Tennessee:					
Bradley	10,787	850	Cleveland	5.549	1,500
Hamilton	44,663	2,750	Chattanooga	44,604	2,750
Madison	23,578	1,550	Jackson	15,779	1,800
Montgomery	15,124	1,550	Clarksville	8,548	2,000
Texas:					
Anderson	19,168	1,500	Palestine	10,482	2,250
Cameron	16,641	1,500	Brownsville	10,517	2,000
Childress	5,720	1,300	Childress	3,818	2,400
Cooke	18,979	1,500	Gainesville	7,624	2,000
Gregg	8,985	1,500	Longview	5,155	2,400
Harrison	25,791	1,500	Marshall	11,452	2,500
Utah:					
Boxelder	10,209	1,500	Brigham	3,685	2,700
Weber	9,599	2,000	Ogden	25,580	3,800
Virginia:					
Albemarle	29,871	1,350	Charlottesville	5,765	1,689
Campbell	23,043	1,200	Lynchburg	29,494	3,000
Dinwiddie	15,442	1,325	Petersburg	24,127	2,500
Norfolk	52,744	3,105	Portsmouth	33,190	2,000
Pittsylvania	50,709	1,500	Danville	19,020	2,124
Washington	32,830	1,615	Bristol	6,247	2,000
Washington:					
Chehalis	10,907	2,000	Aberdeen	13,660	2,250
Chelan	11,054	1,200	Wenatchee	4,050	1,800
Clarke	16,815	1,200	Vancouver	9,300	2,160
Jefferson	4,156	1,000	Port Townsend	4,181	1,700
Pacific	7,055	1,200	South Bend	3,023	1,800
Skagit	17,800	1,200	Anacortes	4,168	2,100

TABLE 3.—*Salaries of county superintendents and of superintendents of cities in the same counties, with population of county and city*—Continued.

State and county.	Population of territory under county superintendent.	Salary of county superintendent.	City.	Population of city.	Salary of city superintendent.
West Virginia:					
Berkeley	11,301	$973	Martinsburg	10,698	$1,650
Brooke	6,909	850	Wellsburg	4,189	1,800
Mercer	24,156	1,323	Bluefield	11,188	2,500
Monongalia	15,184	1,139	Morgantown	9,150	2,200
Taylor	8,991	931	Grafton	7,563	2,000
Wood	20,519	1,273	Parkersburg	17,842	3,000
Wisconsin:					
Eau Claire	14,411	1,000	Eau Claire	18,310	2,600
Langlade	9,866	1,500	Antigo	7,196	2,000
Marinette	17,227	1,200	Marinette	14,610	3,000
Oneida	5,796	1,200	Rhinelander	5,637	2,400
Wyoming:					
Carbon	7,026	900	Rawlins	4,256	2,000
Laramie	14,807	900	Cheyenne	11,320	2,800
Sheridan	7,916	900	Sheridan	8,408	3,000
Sweetwater	5,797	900	Rock Springs	5,778	2,400

Table 4 gives the salaries of the county and other rural superintendents distributed according to the number receiving less than $500, the numbers receiving $500, $600, $700, etc., up to $3,000 and over. Salaries between the even hundreds of dollars have been included with the nearest even amount. A study of the salaries given in detail in Table 4 shows that most of the salaries are even hundreds. The total number of superintendents receiving each salary is given at the bottom of the table; similar data are given also in per cents. It will be noted that 1.7 per cent of the rural superintendents receive less than $500 a year, that approximately 25 per cent receive less than $1,100, that 25 per cent receive from $1,100 to $1,300, inclusive; 25 per cent receive $1,400 or $1,500 and 25 per cent receive $1,600 or over. This last figure includes 35 superintendents, or 1.1 per cent who receive over $3,000.

For the sake of those who desire information relative to county superintendents only, their salaries also are summarized at the bottom of the table. Among the 2,640 superintendents given are included the division superintendents of Virginia, who in fact are county superintendents with the exception of 10 who have more than one county. Of them 39, or 1.5 per cent, receive less than $500 per year, and nearly 25 per cent receive less than $1,000; 25 per cent from $1,000 to $1,300, inclusive; 25 per cent $1,400 or $1,500, and 25 per cent $1,600 or over.

Table 5 gives the salaries of the city superintendents distributed in the same manner as the salaries of the rural superintendents, from $1,000 to $4,000. Five, or two-tenths of one per cent, receive less than $1,000; 25 per cent less than $1,800; 25 per cent, $1,800, $1,900, and $2,000; 25 per cent, $2,000 to $2,500; and 25 per cent, $2,500 or over.

TABLE 4.—*Salaries of county and other rural superintendents.*

States.	Title of office.	Number of superintendents.	Less than $500.	$500.	$600.	$700.	$800.	$900.	$1,000.	$1,100.	$1,200.	$1,300.	$1,400.	$1,500.	$1,600.	$1,700.	$1,800.	$1,900.	$2,000.	$2,100.	$2,200.	$2,300.	$2,400.	$2,500.	$2,600.	$2,700.	$2,800.	$2,900.	$3,000.	Over $3,000.
Alabama	County superintendent	67				1	2		7	4	13	4	8	7	1	3	5	1	4	2		1	1						1	2
Arizona	do	14						2	1		1		1	3			1		3				2							
Arkansas	do	23					1			2	2	1	7	6	1	1	1						1							
California	do	57	2		3	1	1		3					6	2		9		7	2	1	1	8	1		3			3	4
Colorado	do	63	2	2				14		25				11					5								4			
Connecticut	Supervising agent																													
Delaware	County superintendent	3									3																			
Florida	do	52		1	2			3	1	1	17	2	5	9			3		1	2			1					1		3
Georgia	do	152		3	28	10	14	21	19	9	20	3	8	9	1		2						1			1				3
Idaho	do	33							11	3	10	3		5			1													
Illinois	do	102										[2] 8	2	31			15		22			[3] 11		7		1	[4] 3		1	1
Indiana	do	92					1	1	1			1	83											5						
Iowa	do	99												87	2	1	3		5			1								
Kansas	do	105		5	10		10	2	10	9	55						4													
Kentucky	do	120	3	1	25	11	20	12	17	3	11	4	1	6	1		3							1						
Louisiana	Parish superintendent	64			1		1	1			10	1	5	11	4	3	13		4	2	1			4					1	2
Maine	Union superintendent	84		1				2	1	2	28	11	8	8	8	4	5	1	3	1	1									
Maryland	County superintendent	23															11		7					1					3	1
Massachusetts	Union superintendent	62												12	12	10	13	4	4	2		1	1			1	2			
Michigan	County commissioner	83	4	5	3	2	4		7	3	15		4	22	1	1	3		7	1				1						
Minnesota	County superintendent	86		2			3	2	6	5	14	4	2	13	3	6	14	2	3	1	1	1	1	1			1		1	
Mississippi	do	56							2	1	15		3	3	1	2	29													
Missouri	do	114				24	19	20	12	15	7	9	3	5																
Montana	do	41									21			19					1											
Nebraska	do	93	4		2	2	4		11	5	1	22	20	4	8	1	6		1		2									
Nevada	Deputy State superintendent.	5																	5											
New Hampshire	Union superintendent	32												2		4	10	4	4	3	2		1		2					
New Jersey	County superintendent	21																											21	
New Mexico	do	25									1	1	3	6			10		4											
New York	District superintendent	207									132	2	24	18	2	12	7		5				2	1					2	
North Carolina	County superintendent	100	4	3	7	1	6	16	9	2	18	2	2	13	1	1	11		1				2	1						
North Dakota	do	52							1		2		7	1	15	14	5		7											
Ohio	do	88								1			2	6	4	7	10	4	30	3	1	2	3	7		1	1		3	3
Oklahoma	do	77									35		31		7		4													
Oregon	do	35	1		2			2	5		13	2		3	3		3							1						
Pennsylvania	do	66												5	2	2	1	1	16		2	4	2	11			1		7	12
Rhode Island	Town superintendent	17	[1] 13											2		2														
South Carolina	County superintendent	43			5	2	7	8	3	3	10			3			2													

[1] These 13 are all members of school boards serving part time as superintendents.

[2] All are $1,250.

[3] All are $2,250.

[4] All are $2,750.

States.	Title of office.	Number of superintendents.	Less than $500.	$500.	$600.	$700.	$800.	$900.	$1,000.	$1,100.	$1,200.	$1,300.	$1,400.	$1,500.	$1,600.	$1,700.	$1,800.	$1,900.	$2,000.	$2,100.	$2,200.	$2,300.	$2,400.	$2,500.	$2,600.	$2,700.	$2,800.	$2,900.	$3,000.	Over $3,000.
South Dakota	....do	60	....	4	....	1	4	4	4	4	7	5	3	24	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Tennessee	....do	96	9	7	10	23	11	9	6	1	4	2	5	1	4	....	1	....	....	....	....	....	1	....	....	....	2	....	....	....
Texas	....do	129	....	....	....	....	....	....	1	2	....	27	17	82	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Utah	....do	32	4	1	....	1	3	....	....	1	2	1	....	4	2	....	4	....	5	1	....	....	....	....	....	2	....	....	....	1
Vermont	District superintendent	54	....	....	....	....	....	....	....	....	....	....	....	28	11	5	10	....	....	....	....	....	....	....	....	....	....	....	....	....
Virginia	Division superintendent	86	4	1	....	2	3	9	10	6	12	8	4	6	6	1	3	4	4	....	....	....	....	1	1	....	....	....	....	1
Washington	County superintendent	40	2	2	4	2	4	....	3	2	13	....	....	....	....	....	2	....	6	....	....	....	....	....	....	....	....	....	....	....
West Virginia	....do	54	....	....	....	....	2	17	15	7	5	3	2	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Wisconsin	....do	71	....	....	....	....	....	....	15	5	30	2	8	6	2	....	2	....	....	....	....	....	....	1	....	....	....	....	....	....
Wyoming	....do	21	....	7	....	....	7	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
All superintendents.	....	3,100	52	45	102	83	127	152	181	121	527	128	268	490	104	80	226	21	164	20	11	22	27	44	3	9	14	1	43	34
Per cent	....	....	1.7	1.4	3.3	2.7	4.1	4.9	5.8	3.9	17.0	4.1	8.6	15.8	3.3	2.6	7.3	.7	5.3	.6	.4	.7	.9	1.4	.1	.3	.5	....	1.4	1.1
County superintendents only.	....	2,639	39	44	102	83	127	150	180	119	367	115	236	420	71	43	181	12	143	140	8	21	23	43	1	8	12	1	41	34
Per cent	....	....	1.5	1.5	3.9	3.1	4.8	5.7	6.8	4.5	13.9	4.3	8.9	15.9	2.7	1.6	7.0	.5	5.4	.5	.3	.8	.9	1.6	....	.3	.5	....	1.5	1.3

TABLE 5.—*Salaries of city superintendents in cities of more than 2,500 population.*

States.	Number of superintendents.	Less than $1,000.	$1,000.	$1,100.	$1,200.	$1,300.	$1,400.	$1,500.	$1,600.	$1,700.	$1,800.	$1,900.	$2,000.	$2,100.	$2,200.	$2,300.	$2,400.	$2,500.	$2,600.	$2,700.	$2,800.	$2,900.	$3,000.	$3,100.	$3,200.	$3,300.	$3,400.	$3,500.	$3,600.	$3,700.	$3,800.	$3,900.	$4,000.	Over $4,000.
Alabama	28	....	1	2	1	1	....	5	....	2	5	....	3	2	1	....	....	1	....	1	....	....	1	....	....	1	....	....	....	....	....	....	....	1
Arizona	12	....	....	....	....	....	1	....	....	....	1	....	1	....	....	....	1	2	....	3	....	....	1	....	1	....	....	....	....	....	....	....	1	....
Arkansas	25	....	1	....	1	1	2	6	2	1	2	....	4	....	....	....	1	....	....	....	....	....	3	....	1	....	....	....	....	....	....	....	....	....
California	66	1	....	....	....	....	....	....	....	1	8	2	5	1	3	2	4	6	2	3	2	2	12	....	1	1	....	....	3	....	....	....	3	4
Colorado	27	....	....	....	....	....	....	1	1	1	1	1	2	1	1	2	2	3	1	2	1	....	3	....	....	....	....	....	....	....	2	....	....	2
Connecticut	46	....	....	....	1	1	3	4	3	1	4	....	3	2	2	1	3	4	....	....	1	....	2	....	....	3	1	3	....	....	....	....	1	3
Delaware	4	....	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
District of Columbia	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Florida	24	....	....	1	2	2	1	2	2	....	5	....	4	1	....	1	....	....	....	1	....	....	....	....	1	....	....	1	....	....	....	....	....	....
Georgia	40	....	....	....	1	....	....	1	3	3	9	1	6	2	1	....	4	2	....	....	....	....	3	....	....	....	....	....	....	....	....	....	4	....
Idaho	12	....	....	....	....	....	....	....	....	....	....	....	4	1	....	1	....	1	....	1	2	....	1	....	....	1	....	....	....	....	....	....	....	....
Illinois	143	1	....	1	6	1	8	12	14	6	11	4	19	4	7	6	6	5	3	1	2	....	7	....	2	2	1	3	1	....	1	....	3	6

TABLE 5.—*Salaries of city superintendents in cities of more than 2,500 population*—Continued.

States.	Number of superintendents.	Less than $1,000.	$1,000.	$1,100.	$1,200.	$1,300.	$1,400.	$1,500.	$1,600.	$1,700.	$1,800.	$1,900.	$2,000.	$2,100.	$2,200.	$2,300.	$2,400.	$2,500.	$2,600.	$2,700.	$2,800.	$2,900.	$3,000.	$3,100.	$3,200	$3,300.	$3,400.	$3,500.	$3,600.	$3,700.	$3,800.	$3,900.	$4,000.	Over $4,000.
Indiana	73	....	....	1	2	1	1	10	1	3	10	3	8	2	2	1	9	4	....	1	1	....	5	1	1	....	....	....	....	....	1	....	1	4
Iowa	71	1	....	....	....	1	1	3	3	6	8	4	15	6	....	2	6	2	2	....	....	1	3	....	....	1	....	2	....	....	....	....	1	3
Kansas	52	....	....	....	1	1	....	7	7	6	4	....	9	1	3	1	2	3	1	....	....	....	2	....	....	1	....	1	1	....	....	....	....	1
Kentucky	39	....	....	....	1	2	2	9	3	....	5	....	6	1	....	....	2	5	....	....	1	....	....	....	....	....	....	1	....	....	....	....	....	1
Louisiana	22	....	....	....	1	1	4	3	1	2	3	....	1	2	....	....	....	1	....	1	....	....	....	....	....	....	....	....	1	....	....	....	....	1
Maine	10	....	....	....	....	....	....	....	3	....	....	....	1	1	1	1	....	2	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....
Maryland	20	....	....	....	1	1	7	4	2	....	3	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Massachusetts	105	....	....	....	1	....	1	1	....	6	7	....	10	3	11	11	7	9	2	2	2	2	12	1	1	2	1	4	1	....	....	....	2	6
Michigan	74	....	....	....	....	....	....	3	4	4	4	9	9	1	2	2	3	5	1	3	5	2	2	1	....	....	....	3	3	....	1	....	3	4
Minnesota	48	....	....	....	1	....	....	1	....	1	2	3	6	5	5	4	3	3	3	1	1	....	2	1	....	....	....	....	....	....	....	....	1	5
Mississippi	28	....	....	1	1	....	1	1	2	2	8	1	1	....	....	4	3	1	....	....	....	....	1	....	....	1	....	....	....	....	....	....	....	....
Missouri	61	....	1	1	5	2	6	9	4	4	4	2	4	2	....	2	6	1	....	1	1	....	3	....	1	....	....	....	....	....	....	....	....	2
Montana	14	....	....	....	....	....	....	....	....	....	....	....	1	....	1	....	....	2	1	....	1	....	3	....	2	....	....	....	....	....	....	....	2	1
Nebraska	26	....	....	....	....	....	1	2	1	2	4	2	3	1	1	1	3	....	1	1	....	....	1	....	....	....	....	....	....	....	....	....	1	1
Nevada	8	....	....	....	....	....	....	....	....	....	....	....	2	2	....	....	1	....	....	....	....	....	2	....	....	1	....	....	....	....	....	....	....	....
New Hampshire	8	....	....	....	....	....	....	....	....	....	....	1	1	1	1	....	....	1	....	1	1	....	....	....	....	....	....	....	....	....	....	....	1	....
New Jersey	92	....	....	....	....	....	1	3	3	6	4	2	8	2	9	1	2	11	....	2	2	....	3	....	1	....	1	7	5	1	4	....	5	9
New Mexico	10	....	....	1	....	....	....	....	1	....	2	1	2	....	....	....	2	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
New York	147	....	....	....	....	2	3	6	5	9	13	9	17	3	4	7	9	17	5	2	2	2	10	1	2	2	....	5	1	....	....	....	4	7
North Carolina	31	....	1	....	1	....	3	6	....	2	10	....	2	....	1	....	2	2	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....
North Dakota	13	....	....	....	....	....	....	....	....	....	....	....	2	....	2	2	1	4	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1	....
Ohio	133	....	....	1	1	2	6	2	11	7	14	8	18	5	....	9	10	13	1	....	2	3	6	1	1	....	2	1	....	....	....	1	1	7
Oklahoma	44	....	....	1	....	....	4	11	1	3	9	....	2	2	1	1	4	1	1	....	....	....	....	....	....	....	....	....	1	....	2	....	....	....
Oregon	19	....	....	....	....	....	....	....	....	....	4	2	4	2	2	2	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Pennsylvania	235	1	4	7	12	8	14	29	6	8	45	5	26	4	4	4	14	8	4	2	3	1	10	....	1	1	1	7	1	....	....	....	2	3
Rhode Island	19	....	....	....	....	....	....	5	....	2	2	....	4	....	....	1	1	1	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	1
South Carolina	20	....	....	....	2	1	....	3	2	1	2	....	1	3	2	....	....	2	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....
South Dakota	11	....	....	....	....	....	....	....	....	....	1	1	1	1	....	1	1	....	1	....	....	....	1	....	1	....	....	1	1	....	....	....	....	....
Tennessee	29	1	1	1	2	2	2	5	....	2	5	....	3	....	....	1	....	....	1	....	1	....	1	....	....	....	....	....	....	....	....	....	....	1
Texas	62	....	....	1	....	....	1	9	1	1	13	....	8	....	2	4	6	5	1	....	....	....	2	....	....	1	....	1	1	....	....	....	2	3
Utah	15	....	....	....	....	....	....	....	....	....	3	....	2	3	....	....	2	....	....	2	....	....	....	....	....	....	1	....	....	....	1	....	....	1
Vermont	12	....	....	....	....	....	....	1	1	1	....	2	....	3	....	....	2	....	....	....	1	....	....	1	....	....	....	....	....	....	....	....	....	....
Virginia	20	....	....	....	3	....	1	2	2	1	1	....	4	1	....	....	....	2	....	....	....	....	1	....	1	....	....	....	....	....	....	....	....	1
Washington	28	....	....	....	1	....	....	1	1	1	5	1	4	2	1	1	3	....	....	1	....	....	....	....	1	1	....	....	....	....	....	....	....	4
West Virginia	27	....	1	....	....	....	2	6	4	1	3	....	2	....	1	....	....	1	1	....	1	....	3	....	....	1	....	....	....	....	....	....	....	....
Wisconsin	73	....	....	....	1	1	....	4	2	6	5	4	13	7	2	1	2	9	4	3	1	....	6	....	1	....	....	....	....	....	....	....	....	1
Wyoming	7	....	....	....	....	....	....	....	....	....	....	1	1	....	1	....	2	....	....	....	1	....	1	....	....	....	....	....	....	....	....	....	....	....
United States	2,134	5	10	19	52	31	76	177	96	102	249	69	253	80	74	77	131	140	36	37	35	13	115	8	20	20	8	40	21	1	12	1	39	87
Per cent	......	0.2	.5	.9	2.4	1.5	3.5	8.3	4.5	4.8	11.7	3.2	11.9	3.7	3.5	3.6	6.1	6.5	1.7	1.7	1.6	.6	5.4	.4	1.0	1.0	.4	1.9	1.0	....	.6	....	1.9	4.1

The 34 rural superintendents receiving over $3,000 per year are all county superintendents and are in the following States:

Alabama	2
1 at $5,000.	
1 at $4,000.	
California	5
2 at $4,000.	
1 at $3,600.	
1 at $3,300.	
1 at $3,250.	
Florida	3
1 at $4,500.	
1 at $3,550.	
1 at $3,420.	
Georgia	3
3 at $4,000.	
Illinois	1
1 at $7,500.	
Louisiana	2
1 at $5,000.	
1 at $3,600.	
Maryland	1
1 at $5,000.	
Ohio	3
1 at $3,500.	
1 at $3,250.	
1 at $3,050.	
Pennsylvania	12
1 at $8,500.	
1 at $7,000.	
3 at $5,000.	
1 at $4,220.	
1 at $4,000.	
3 at $3,500.	
1 at $3,100.	
Utah	1
1 at $3,400.	
Virginia	1
1 at $3,105.	

The 52 superintendents receiving less than $500 a year include the 13 Rhode Island school-board members who serve part time as superintendents of schools, and 39 county superintendents as follows:

California	2
1 at $400.	
1 at $200.	
Colorado	2
2 at $100.	
Kentucky	3
1 at $400.	
1 at $150.	
1 at $110.	
Michigan	4
1 at $400.	
1 at $300.	
1 at $250.	
Nebraska	4
1 at $450.	
1 at $445.	
Nebraska—Continued.	
1 at $423.	
1 at $405.	
North Carolina	4
1 at $423.	
1 at $315.	
1 at $300.	
Oregon	1
1 at $400.	
Tennessee	9
1 at $475.	
1 at $450.	
1 at $441.	
2 at $400.	
2 at $300.	
Tennessee—Continued.	
1 at $250.	
1 at $230.	
Utah	4
1 at $400.	
1 at $249.	
1 at $200.	
1 at $150.	
Virginia	4
1 at $460.	
1 at $390.	
1 at $320.	
1 at $231.	
Washington	2
1 at $400.	
1 at $200.	

The 87 city superintendents receiving more than $4,000 a year are in the following States:

Alabama	1
1 at $4,200.	
California	4
1 at $8,000.	
3 at $4,500.	
Colorado	2
1 at $6,000.	
1 at $4,800.	
Connecticut	3
1 at $5,000.	
1 at $4,600.	
1 at $4,200.	
Delaware	1
1 at $4,500.	
District of Columbia	1
1 at $6,000.	
Illinois	6
1 at $10,000.	
1 at $7,500.	
1 at $5,000.	
1 at $4,500.	
1 at $4,400.	
1 at $4,200.	
Indiana	4
1 at $6,000.	
1 at $5,500.	
2 at $4,200.	
Iowa	3
2 at $5,000.	
1 at $4,200.	
Kansas	1
1 at $4,800.	
Kentucky	1
1 at $5,000.	
Louisiana	1
1 at $5,000.	
Maryland	1
1 at $5,000.	
Massachusetts	6
1 at $10,000.	
2 at $5,000.	
3 at $4,500.	
Michigan	4
1 at $9,000.	
1 at $5,400.	
2 at $4,500.	
Minnesota	5
1 at $8,000.	
1 at $5,000.	
2 at $4,500.	
1 at $4,200.	
Missouri	2
1 at $8,000.	
1 at $6,000.	
Montana	1
1 at $4,500.	
Nebraska	1
1 at $5,400.	
New Jersey	9
2 at $7,000.	
1 at $6,000.	
1 at $4,750.	
2 at $4,500.	
3 at $4,250.	
New York	7
1 at $10,000.	
1 at $6,500.	
1 at $6,000.	
1 at $5,500.	
1 at $5,000.	
2 at $4,500.	
Ohio	7
1 at $10,000.	
1 at $6,500.	
2 at $6,000.	
2 at $5,000.	
1 at $4,750.	
Oregon	1
1 at $5,000.	
Pennsylvania	3
2 at $9,000.	
1 at $5,000.	
Rhode Island	1
1 at $5,000.	
Tennessee	1
1 at $5,000.	
Texas	3
2 at $5,000.	
1 at $4,200.	
Utah	1
1 at $4,800.	
Virginia	1
1 at $5,000.	
Washington	4
1 at $7,500.	
1 at $5,000.	
1 at $4,800.	
1 at $4,250.	
Wisconsin	1
1 at $7,500.	

The five city superintendents receiving less than $1,000 a year are in the following States:

California, 1 at	$600
Illinois, 1 at	800
Iowa, 1 at	900
Pennsylvania, 1 at	$700
Tennessee, 1 at	900

TABLE 6.—*Salaries of county and city superintendents of schools.*

ALABAMA.

County.	Superintendent.
Autauga	$1,029
Baldwin	2,000
Barbour	1,411
Bibb	1,256
Blount	1,080
Bullock	2,000
Butler	1,696
Calhoun	2,324
Chambers	2,000
Cherokee	1,020
Chilton	1,500
Choctaw	1,022
Clarke	1,500
Clay	1,200
Cleburne	680
Coffee	1,500
Colbert	1,196
Conecuh	1,200
Coosa	1,200
Covington	1,500
Crenshaw	1,092
Cullman	1,519
Dale	1,400
Dallas	2,400
Dekalb	1,800
Elmore	1,484
Escambia	1,690
Etowah	1,500
Fayette	1,200
Franklin	980
Geneva	1,183
Greene	1,200
Hale	1,150
Henry	800
Houston	1,200
Jackson	1,411
Jefferson	5,000
Lamar	1,200
Lauderdale	1,600
Lawrence	986
Lee	1,356
Limestone	1,800
Lowndes	1,800
Macon	1,260
Madison	4,000
Marengo	1,838
Marion	1,000
Marshall	1,125
Mobile	2,100
Monroe	1,650
Montgomery	1,800
Morgan	1,850
Perry	1,357
Pickens	1,200
Pike	1,336
Randolph	1,248
Russell	1,139
Shelby	1,200
St. Clair	1,282
Sumter	1,399
Talladega	2,072
Tallapoosa	1,350
Tuscaloosa	3,000
Walker	2,000
Washington	757
Wilcox	1,372
Winston	1,000
Average for 67 counties	1,543

City.	Superintendent.	Assistant.
Alabama City	$1,500	....
Anniston	2,100	....
Attalla	1,100	....
Bessemer	2,200	....
Birmingham	4,200	$2,700
Decatur	1,680	....
Dothan	2,500	....
Eufaula	1,800	....
Florence	1,500	....
Gadsden	2,000	....
Girard	1,250	....
Greenville	1,500	....
Huntsville	1,800	....
Jasper	1,800	....
Lanett	1,500	....
Mobile	3,300	2,100
Montgomery	3,000	....
New Decatur	1,650	....
Opelika	1,800	....
Phoenix	1,000	....
Selma	2,700	....
Sheffield	1,238	....
Talladega	2,025	....
Troy	1,800	....
Tuscaloosa	2,100	....
Tuscumbia	1,125	....
Tuskegee	1,515	....
Union Springs	2,000	1,200
Average for 28 cities	1,851	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

ARIZONA.

County.	Superintendent.	City.	Superintendent.	Assistant.
Apache	$1,000	Benson	$1,800	
Cochise	2,400	Bisbee	3,200	
Coconino	1,500	Clifton	2,656	
Gila	2,000	Douglas	2,700	$1,500
Graham	1,200	Globe	2,500	
Greenlee	2,000	Morenci	2,700	
Maricopa	2,400	Nogales	2,500	
Mohave	900	Phoenix	4,000	
Navajo	1,400	Prescott	2,400	
Pima	1,500	Tombstone	1,350	
Pinal	1,500	Tucson	3,000	
Santa Cruz	900	Yuma	2,000	
Yavapai	2,000			
Yuma	1,800	Average for 12 cities	2,567	
Average for 14 counties	1,600			

ARKANSAS.[1]

County.	Superintendent.	City.	Superintendent.	Assistant.
Arkansas	$1,500	Argenta	$2,400	
Ashley		Arkadelphia	2,000	$900
Baxter		Batesville	1,620	
Benton	1,500	Blytheville	1,500	
Boone		Camden	1,650	
Bradley		Eldorado	1,500	
Calhoun		Eureka Springs	1,600	
Carroll		Fayetteville	1,200	
Chicot	1,250	Fordyce	1,500	
Clark		Fort Smith	3,200	1,500
Clay		Helena	2,000	
Cleburne	1,100	Hope	1,500	
Cleveland		Hot Springs	3,000	1,800
Columbia		Jonesboro	2,000	
Conway		Little Rock	3,000	
Craighead		Malvern	1,500	
Crawford	1,200	Marianna	1,800	
Crittenden	1,400	Newport	1,800	
Cross		Paragould	1,250	
Dallas		Pine Bluff	3,000	
Desha		Prescott	1,350	
Drew		Rogers	1,000	
Faulkner		Russellville	1,500	
Franklin		Stuttgart	2,000	720
Fulton		Van Buren	1,350	
Garland	1,400			
Grant		Average for 25 cities	1,849	
Greene				
Hempstead				
Hot Spring				
Howard				
Independence				
Izard				
Jackson	1,500			
Jefferson	2,400			
Johnson	1,400			
Lafayette				
Lawrence				
Lee	1,400			
Lincoln				
Little River				
Logan				
Lonoke	1,400			
Madison				
Marion				
Miller	1,500			
Mississippi	1,500			
Monroe	1,400			
Montgomery	1,000			
Nevada				
Newton	800			
Ouachita				
Perry				
Phillips				
Pike				
Poinsett	1,800			
Polk	1,400			
Pope				
Prairie	1,200			
Pulaski				

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[1] No county superintendents in counties where salaries are not given.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

ARKANSAS—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Randolph	....			
Saline	....			
Scott	....			
Searcy	....			
Sebastian	$1,600			
Sevier	....			
Sharp	....			
St. Francis	....			
Stone	....			
Union	....			
Van Buren	....			
Washington	1,700			
White	1,500			
Woodruff	....			
Yell	....			
Average for 23 counties	1,424			

CALIFORNIA.

County.	Superintendent.	Deputy.	City.	Superintendent.	Assistant.
Alameda	$4,000	[1] $2,400	Alameda	$3,000	....
Alpine	200	....	Alhambra	3,000	....
Amador	1,500	....	Anaheim	2,000	....
Butte	2,000	720	Bakersfield	2,820	2,000
Calaveras	1,500	....	Berkeley	3,600	....
Colusa	2,400	....	Chico	2,900	....
Contra Costa	3,250	1,200	Coalinga	1,800	....
Del Norte	720	....	Colton	2,500	....
El Dorado	1,800	....	Corona	2,250	....
Fresno	2,700	[2] 1,800	Emeryville	1,920	....
Glenn	2,700	....	Eureka	2,500	....
Humboldt	2,500	900	Fresno	4,000	....
Imperial	2,400	[3] 900	Glendale	2,200	....
Inyo	1,500	....	Grass Valley	2,100	1,300
Kern	3,000	[4] 1,800	Hanford	2,500	....
Kings	1,800	600	Hayward	2,610	....
Lake	1,000	....	Lodi	1,800	....
Lassen	1,500	....	Long Beach	4,500	....
Los Angeles	3,600	[5] 2,700	Los Angeles	8,000	[6] 3,800
Madera	1,800	500	Marysville	600	....
Marin	2,400	1,200	Merced	2,000	1,200
Mariposa	600	....	Mill Valley	2,400	....
Mendocino	2,400	....	Modesto	3,000	....
Merced	2,000	1,179	Monrovia	2,800	....
Modoc	1,500	....	Monterey	1,680	....
Mono	400	....	Napa	1,800	....
Monterey	2,400	1,047	Nevada City	2,000	....
Napa	1,600	900	Oakland	4,500	[7] 3,600
Nevada	2,000	....	Ontario	1,800	1,000
Orange	2,250	900	Orange	1,900	....
Placer	1,800	600	Oroville	1,750	....
Plumas	800	....	Oxnard	2,400	....
Riverside	2,400	1,200	Palo Alto	2,600	....
Sacramento	3,000	2,100	Pasadena	4,500	....
San Benito	1,800	....	Petaluma	3,000	....
San Bernardino	2,400	1,200	Pomona	3,000	....
San Diego	2,700	[8] 2,000	Porterville	2,400	....
San Francisco [9]	....	(10)	Red Bluff	1,800	....
San Joaquin	3,300	1,200	Redondo Beach	1,800	....
San Luis Obispo	1,500	900	Redlands	3,300	....
San Mateo	2,100	....	Richmond	3,000	....
Santa Barbara	2,000	1,080	Riverside	3,000	....

[1] Also 2 at $1,500.
[2] Also 1 at $1,800, 1 at $1,500.
[3] Also 1 at $263.
[4] Also 2 at $1,200.
[5] Also 1 at $2,700, 1 at $2,400, 1 at $1,800, 2 at $1,500, 2 at $1,200, 1 at $1,380, 1 at $1,080, and 3 at $900.
[6] Additional assistant at $3,800, 2 at $3,600, and 1 at $3,000.
[7] One additional at $3,600.
[8] Also 2 at $1,200.
[9] See San Francisco city.
(10) Four at $3,000, 1 at $1,800, 1 at $1,260, and 1 at $1,200.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

CALIFORNIA—Continued.

County.	Superintendent.	Deputy.	City.	Superintendent.	Assistant.
Santa Clara	$3,000	$1,320	Roseville	$2,000	....
Santa Cruz	1,800	600	Sacramento	3,600	$2,100
Shasta	1,800	600	Salinas	2,400	....
Sierra	625	....	San Bernardino	2,500	....
Siskiyou	2,000	....	San Diego	4,000	3,000
Solano	2,400	900	San Francisco	4,000	3,000
Sonoma	2,000	1,500	San Jose	3,600	1,600
Stanislaus	2,000	1,020	San Leandro	....	....
Sutter	1,600	....	San Luis Obispo	2,500	....
Tehama	1,800	600	San Mateo	2,700	....
Trinity	1,000	....	San Rafael	3,000	....
Tulare	2,200	1,200	Santa Ana	3,000	....
Tuolumne	1,000	....	Santa Barbara	3,000	....
Ventura	2,100	780	Santa Cruz	2,700	....
Yolo	1,800	....	Santa Monica	2,300	1,500
Yuba	600	....	Santa Rosa	3,000	....
			South Pasadena	3,200	....
Average for 57 counties	1,771	....	Stockton	3,000	[1] 2,400
			Tulare	2,000	....
			Vallejo	2,700	....
			Venice	2,900	....
			Ventura	2,000	....
			Watsonville	2,500	....
			Whittier	2,200	....
			Woodland	1,800	....
			Average for 66 cities	2,722	....

COLORADO.

County.	Superintendent.	City.	Superintendent.	Assistant.
Alamosa	$1,100	Alamosa	$2,000	$1,200
Adams	1,500	Boulder	2,500	....
Arapahoe	1,100	Canon City	1,800	....
Archuleta	900	Colorado City	1,700	....
Baca	900	Colorado Springs	3,750	....
Bent	900	Creeley	2,700	....
Boulder	2,000	Cripple Creek	3,000	....
Chaffee	1,500	Denver	6,000	4,000
Cheyenne	1,100	Durango (District No. 9)	2,500	1,485
Clear Creek	900	Englewood	1,500	....
Conejos	1,100	Florence	1,560	....
Costilla	1,100	Fort Collins	2,400	....
Crowley	1,100	Fort Morgan	2,400	....
Custer	900	Grand Junction	2,750	....
Delta	1,500	Greeley	2,700	....
Denver	900	La Junta	2,600	....
Dolores	100	Lamar	2,200	....
Douglas	1,100	Leadville	2,100	....
Eagle	1,100	Longmont	2,300	....
Elbert	1,100	Loveland	1,900	....
El Paso	2,800	Montrose	2,300	1,200
Fremont	2,000	Pueblo:		
Garfield	2,000	District No. 1	3,750	....
Gilpin	1,100	District No. 20	4,800	....
Grand	900	Rocky Ford	2,500	....
Gunnison	1,500	Salida	2,000	....
Hinsdale	100	Sterling	3,000	1,500
Huerfano	1,500	Trinidad	3,000	....
Jackson	900			
Jefferson	1,100	Average for 27 cities	2,656	....
Kiowa	900			
Kit Carson	1,100			
Lake	1,100			
La Plata	900			
Larimer	2,000			
Las Animas	2,800			
Lincoln	1,100			
Logan	1,500			
Mesa	2,000			
Mineral	500			
Moffat	900			
Montezuma	900			

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[1] One additional at $2,400.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

COLORADO—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Montrose	$1,500			
Morgan	1,500			
Otero	1,500			
Ouray	1,100			
Park	1,100			
Phillips	1,100			
Pitkin	1,100			
Prowers	1,500			
Pueblo	2,800			
Rio Blanco	1,100			
Rio Grande	1,100			
Routt	1,500			
Saguache	1,100			
San Juan	500			
San Miguel	1,100			
Sedgwick	900			
Summit	900			
Teller	1,100			
Washington	1,100			
Weld	2,800			
Yuma	1,100			
Average for 63 counties	1,254			

DELAWARE.

County.	Superintendent.	City.	Superintendent.	Assistant.
Kent	$1,200	Dover[1]	$1,200	....
New Castle	1,200	Milford[1]	1,200	....
Sussex	1,200	New Castle[1]	1,200	....
		Wilmington	4,500	$1,500
Average for 3 counties	1,200	Average for 4 cities	2,025	....

FLORIDA.[2]

County.	Superintendent.	City.	Superintendent.	Assistant.
Alachua	$2,004	Arcadia	$2,000	....
Baker	900	Apalachicola	1,080	....
Bay	1,200	Bartow	1,500	....
Bradford	1,200	Bradentown	1,400	....
Brevard	1,200	Daytona	2,000	....
Broward	1,333	De Land	1,500	....
Calhoun	1,200	Fort Pierce	1,200	....
Citrus	1,200	Gainesville	1,600	....
Clay	1,200	Jacksonville	2,700	....
Columbia	1,350	Lakeland	2,000	....
Dade	2,000	Miami	3,500	....
De Soto	2,100	New Smyrna	1,280	....
Duval	4,500	Ocala	1,800	....
Escambia	2,850	Orlando	1,750	....
Franklin	600	Palatka	1,600	....
Gadsden	1,100	Pensacola	1,800	....
Hamilton	1,200	Quincy	2,000	....
Hernando	1,375	Sanford	1,800	....
Hillsboro	3,550	Seabreeze	1,280	....
Holmes	1,200	St. Augustine	1,200	....
Jackson	1,500	St. Petersburg	3,200	....
Jefferson	1,200	Tallahassee	1,800	....
Lafayette	1,150	Tampa	2,100	....
Lake	1,200	West Palm Beach	2,250	....
Lee	1,500			
Leon	1,500	Average for 24 cities	1,848	....
Levy	1,200			
Liberty	900			
Madison	1,300			
Manatee	1,500			
Marion	1,800			
Monroe	1,500			
Nassau	1,200			
Orange	1,800			
Osceola	1,380			
Oskaloosa	860			
Palm Beach	1,800			

[1] Supervising principals, under the county superintendents.

[2] All Florida city superintendents are supervising principals, as cities in Florida are under the charge of the county boards of education and the supervision of the county superintendent.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

FLORIDA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Pasco	$500			
Pinellas	2,375			
Polk	3,420			
Putnam	1,375			
St. John	1,440			
St. Lucie	1,500			
Santa Rosa	1,500			
Seminole	1,500			
Sumter	1,200			
Suwanee	1,200			
Taylor	1,200			
Volusia	2,100			
Wakulla	600			
Walton	1,500			
Washington	1,175			
Average for 52 counties	1,522			

GEORGIA.

County.	Superintendent.	City.	Superintendent.	Assistant.
Appling	$1,200	Albany	$2,000	....
Bacon	675	Americus	2,400	....
Baker	600	Athens	2,400	$1,900
Baldwin	1,150	Atlanta	4,000	3,000
Banks	720	Augusta [1]	4,000	....
Barrow	675	Bainbridge	2,000	....
Bartow	1,000	Barnesville	3,000	....
Ben Hill	900	Brunswick [1]	2,400	....
Berrien	1,350	Carrollton	1,800	....
Bibb	4,000	Cartersville	1,800	....
Bleckley	900	Covington	1,800	....
Brooks	1,200	Cedartown	1,800	....
Bryan	1,000	Columbus	3,000	....
Bulloch	1,600	Cordele	2,200	....
Burke	1,800	Cuthbert	1,500	....
Butts	800	Dalton	1,800	1,200
Calhoun	600	Dawson	1,650	....
Camden	780	Dublin	2,100	1,080
Campbell	1,000	Elberton	1,800	....
Candler	650	Fitzgerald	1,800	....
Carroll	1,200	Fort Valley	2,500	1,000
Catoosa	750	Gainesville	1,650	....
Charlton	700	Hawkinsville	1,600	....
Chatham	4,000	La Grange	2,000	1,200
Chattahoochee	600	Macon [1]	4,000	....
Chattooga	800	Marietta	1,800	....
Cherokee	900	Milledgeville	3,000	....
Clarke	1,032	Monroe	1,600	....
Clay	600	Moultrie	2,000	1,500
Clayton	600	Newnan	2,400	....
Clinch	875	Rome	2,100	....
Cobb	900	Sandersville	2,000	....
Coffee	1,200	Savannah [1]	4,000	2,180
Colquitt	1,400	Summerville	1,200	....
Columbia	1,000	Thomasville	1,800	....
Coweta	1,000	Toccoa	1,600	....
Crawford	600	Valdosta	1,850	....
Crisp	1,350	Washington	1,650	1,200
Dade	450	Waycross	2,500	....
Dawson	750	Waynesboro	1,992	....
Decatur	1,500			
Dekalb	1,333	Average for 40 cities	2,212	....
Dodge	1,236			
Dooly	1,050			
Dougherty	900			
Douglas	720			
Early	1,350			
Echols	639			
Effingham	600			
Elbert	1,200			
Emanuel	1,320			
Evans	1,000			
Fannin	660			
Fayette	900			
Floyd	1,350			
Forsyth	600			
Franklin	825			
Fulton	2,700			

[1] County superintendent as well as city superintendent.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

GEORGIA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Gilmer	$600			
Glascock	600			
Glynn	2,400			
Gordon	1,100			
Grady	900			
Greene	1,140			
Gwinnett	1,200			
Habersham	600			
Hall	1,100			
Hancock	1,126			
Haralson	840			
Harris	1,006			
Hart	1,200			
Heard	600			
Henry	1,200			
Houston	1,800			
Irwin	1,200			
Jackson	1,200			
Jasper	750			
Jeff Davis	600			
Jefferson	1,050			
Jenkins	1,466			
Johnson	800			
Jones	1,200			
Laurens	1,500			
Lee	750			
Liberty	900			
Lincoln	600			
Lowndes	1,200			
Lumpkin	600			
Macon	990			
Madison	1,000			
Marion	600			
McDuffie	972			
McIntosh	720			
Meriwether	1,500			
Miller	750			
Milton	600			
Mitchell	1,150			
Monroe	1,500			
Montgomery	1,020			
Morgan	1,500			
Murray	840			
Muscogee	850			
Newton	1,400			
Oconee	600			
Oglethorpe	915			
Paulding	600			
Pickens	900			
Pierce	850			
Pike	1,000			
Polk	987			
Pulaski	900			
Putnam	1,500			
Quitman	600			
Rabun	600			
Randolph	1,425			
Richmond	4,000			
Rockdale	600			
Schley	720			
Screven	1,200			
Spalding	900			
Stephens	450			
Stewart	900			
Sumter	1,000			
Talbot	900			
Taliaferro	450			
Tattnall	1,500			
Taylor	600			
Telfair	900			
Terrell	1,000			
Thomas	1,200			
Tift	1,080			
Toombs	924			
Towns	600			
Troup	900			
Turner	750			
Twiggs	1,200			
Union	600			
Upson	1,200			
Walker	1,050			
Walton	1,350			

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

GEORGIA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Ware	$1,000			
Warren	960			
Washington	1,500			
Wayne	1,283			
Webster	600			
Wheeler	750			
White	600			
Whitfield	900			
Wilcox	1,000			
Wilkes	1,083			
Wilkinson	720			
Worth	1,200			
Average for 152 counties	1,041			

IDAHO.[1]

County.	Superintendent.	City.	Superintendent.	Assistant.
Ada	$1,500	Boise	$3,300	....
Adams	1,000	Caldwell	2,000	....
Bannock	1,500	Coeur d'Alene	2,000	$1,300
Bear Lake	1,000	Idaho Falls	2,750	....
Benewah	1,100	Lewiston	2,750	....
Bingham	1,200	Moscow	2,000	....
Blaine	1,200	Nampa	2,010	1,500
Boise	1,000	Pocatello	3,000	....
Bonner	1,200	Sandpoint	2,250	....
Bonneville	1,200	Twin Falls	2,500	1,800
Boundary	1,100	Wallace	2,700	....
Canyon	1,200	Weiser	2,100	....
Cassia	1,200			
Clearwater	1,200	Average for 12 cities	2,419	....
Custer	1,000			
Franklin	1,500			
Fremont	1,500			
Gem	1,000			
Gooding	1,200			
Idaho	1,800			
Jefferson	1,200			
Kootenai	1,500			
Latah	1,300			
Lemhi	1,000			
Lewis	1,230			
Lincoln	1,000			
Minidoka	1,000			
Nez Perce	1,260			
Oneida	1,000			
Owyhee	1,300			
Power	1,000			
Teton	1,000			
Washington	1,100			
Average for 33 counties	1,197			

ILLINOIS.

County.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Adams	$2,500	$400	Alton	$3,000	....
Alexander	1,500	....	Anna	1,650	....
Bond	1,500	....	Aurora	3,500	....
Boone	1,500	....	Averyville	1,850	....
Brown	1,250	....	Batavia	2,000	....
Bureau	2,250	720	Beardstown	2,100	....
Calhoun	1,250	....	Belleville	1,800	$1,200
Carroll	1,500	....	Belvidere	2,400	....
Cass	1,500	....	Benton	1,400	....
Champaign	2,250	1,200	Berwyn	2,400	....
Christian	2,000	600	Bloomington	3,500	1,600
Clark	1,800	....	Blue Island	3,600	....
Clay	1,500	360	Bridgeport	1,600	....
Clinton	1,500	....	Bushnell	1,500	....
Coles	2,000	400	Cairo	2,250	....

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[1] Salaries of 4 county superintendents not reported by State superintendent to bureau.

Table 6.—*Salaries of county and city superintendents of schools*—Continued.

ILLINOIS—Continued.

County.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Cook	$7,500	[1] $2,500	Canton	$2,200	$1,700
Crawford	1,500	....	Carbondale	1,700	....
Cumberland	1,500	....	Carlinville	1,600	....
Dekalb	3,000	1,000	Carmi	1,620	....
Dewitt	1,500	....	Carterville	1,400	....
Douglas	1,500	....	Centralia	2,250	....
Dupage	2,000	900	Champaign	2,500	....
Edgar	2,000	....	Charleston	2,000	....
Edwards	1,350	....	Chester	1,500	....
Effingham	1,800	....	Chicago	10,000	5,000
Fayette	2,000	300	Chicago Heights	3,000	900
Ford	1,500	....	Cicero	3,250	1,500
Franklin	1,500	....	Clinton	2,200	....
Fulton	2,250	300	Coal City	1,500	....
Gallatin	1,500	....	Collinsville	2,300	....
Greene	1,800	....	Danville	3,500	....
Grundy	1,800	....	Decatur	4,000	1,800
Hamilton	1,800	....	De Kalb	2,000	1,000
Hancock	2,000	....	Dixon:		
Hardin	1,250	....	North Side	1,800	1,000
Henderson	1,250	....	South Side	1,600	....
Henry	2,250	....	Downers Grove	2,200	....
Iroquois	2,250	....	Dundee	2,000	....
Jackson	2,000	....	East Moline	1,800	....
Jasper	1,800	....	East St. Louis	3,000	....
Jefferson	2,000	....	Edwardsville	2,160	....
Jersey	1,500	....	Effingham	1,500	....
Jo Daveiss	1,800	....	Eldorado	1,200	....
Johnson	1,500	....	Elgin	3,400	....
Kane	2,750	1,200	Evanston:		
Kankakee	2,250	1,200	District No. 75	5,000	2,000
Kendall	1,250	....	District No. 76	4,400	900
Knox	2,250	....	Fairbury	2,250	....
Lake	2,000	....	Farmer City	1,500	....
La Salle	2,750	....	Forest Park	2,040	....
Lawrence	1,500	....	Freeport	2,600	....
Lee	2,000	....	Galena	1,400	1,200
Livingston	2,250	1,200	Galesburg	3,300	....
Logan	2,000	1,000	Granite City	2,510	....
Macon	2,250	600	Geneseo	1,600	....
Macoupin	2,250	600	Flora	1,100	....
Madison	2,500	900	Greenville	1,600	....
Marion	2,000	....	Harrisburg	2,000	....
Marshall	1,500	....	Harvard	2,200	1,100
Mason	1,500	....	Harvey	2,300	....
Massac	1,500	....	Havana	1,800	....
McDonough	2,000	....	Herrin	1,700	....
McHenry	2,000	....	Highland	2,000	855
McLean	2,500	1,200	Highland Park	2,900	....
Menard	1,500	....	Hillsboro	1,750	1,200
Mercer	1,800	....	Hoopeston	1,700	....
Monroe	1,500	....	Jerseyville	2,000	1,300
Montgomery	2,000	600	Johnston City	1,350	....
Morgan	2,000	900	Joliet	4,000	1,800
Moultrie	1,500	....	Kankakee	2,500	....
Ogle	2,000	900	Kewanee	3,000	....
Peoria	2,700	1,200	La Grange	3,000	....
Perry	1,500	....	Lake Forest	2,600	1,050
Piatt	1,500	....	La Salle	2,300	....
Pike	2,000	400	Lawrenceville	1,200	....
Pope	1,500	....	Lincoln	2,000	....
Pulaski	1,500	....	Litchfield	1,650	....
Putnam	1,250	....	Lockport	2,000	....
Randolph	2,000	....	Macomb	2,000	....
Richland	1,500	....	Madison	1,500	....
Rock Island	2,500	600	Marion	3,150	....
Saline	1,800	....	Marseilles	1,600	....
Sangamon	2,500	1,320	Marshall	1,400	....
Schuyler	1,500	....	Mattoon	2,400	....
Scott	1,250	....	Maywood (District No. 80)	2,600	....
Shelby	2,000	....	Mendota	1,800	....
Stark	1,250	....	Metropolis	1,250	....
St. Clair	2,750	1,200	Moline	3,000	....
Stephenson	2,000	600	Monmouth	2,100	....
Tazewell	2,000	900	Morris	2,100	1,200
Union	1,200	....	Mound City	1,200	....
Vermilion	2,500	1,200	Mount Carmel	2,000	....
Wabash	1,500	....	Mount Olive	1,400	900
Warren	1,800	600	Mount Vernon	1,800	....

[1] Three additional at $2,500 each.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

ILLINOIS—Continued.

County.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Washington	$1,500		Murphysboro	$1,550	
Wayne	1,800		Naperville	2,200	
White	1,800		Normal	1,900	
Whiteside	2,000		Oak Park	4,200	
Will	2,500	$1,500	Oakland	2,300	
Williamson	1,800		Olney	2,000	$1,000
Winnebago	2,250	720	Ottawa	2,400	
Woodford	1,800	750	Pana	1,450	
			Paris	2,000	
Average for 102 counties	1,907		Paxton	2,000	900
			Pekin	2,100	
			Peoria	2,000	
			Peru	1,600	
			Petersburg	1,500	
			Pinckneyville	1,350	
			Pontiac	1,000	
			Princeton	2,000	
			Quincy	3,750	
			Robinson	1,200	
			Rochelle	2,000	1,200
			Rock Falls	1,600	
			Rockford	4,500	
			Rock Island	3,200	
			St. Charles	2,200	
			Salem	1,500	
			Sandwich	1,500	
			Savanna	1,900	
			Shelbyville	1,800	
			Sparta	1,600	
			Springfield	7,500	[1] 4,500
			Spring Valley	4,000	
			Staunton	1,600	900
			Sterling:		
			District No. 10	1,500	
			District No. 11	1,450	
			Streator	2,400	
			Sullivan	1,200	
			Sycamore	1,700	
			Taylorville	2,000	
			Urbana	2,400	1,960
			Vandalia	1,200	1,100
			Venice	1,800	635
			Virden	1,800	
			Waltonville	800	
			Waukegan	3,000	
			West Hammond	1,900	
			Westville	1,350	
			Wheaton	2,500	
			Whitehall	1,600	
			Wilmette	2,700	
			Winnetka	2,800	
			Woodstock	1,800	
			Average for 143 cities	2,239	

INDIANA.

County.	Superintendent.	City.	Superintendent.	Assistant.
Adams	$1,408	Alexandria	$1,300	
Allen	2,500	Anderson	3,280	
Bartholomew	1,408	Angola	1,350	
Benton	1,408	Attica	1,680	
Blackford	1,408	Auburn	1,900	
Boone	1,408	Aurora	1,800	
Brown	900	Bedford	2,200	
Carroll	1,400	Bicknell	1,800	
Cass	1,408	Bloomington	2,600	
Clark	1,408	Bluffton	1,800	
Clay	1,408	Boonville	1,500	$1,000
Clinton	1,408	Clinton	2,100	
Crawford	1,400	Columbia City	1,900	1,300
Daviess	1,408	Columbus	2,400	
Dearborn	1,408	Connersville	2,200	
Decatur	1,408	Crawfordsville	3,000	

[1] Two additional at $3,000 each.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

INDIANA—Continued.

County.	Superintendent.
Dekalb	$1,408
Delaware	1,408
Dubois	1,408
Elkhart	1,408
Fayette	1,408
Floyd	1,408
Fountain	1,408
Franklin	1,408
Fulton	1,408
Gibson	1,408
Grant	1,408
Greene	1,408
Hamilton	1,408
Hancock	1,408
Harrison	1,408
Hendricks	1,408
Henry	1,408
Howard	1,408
Huntington	1,408
Jackson	1,408
Jasper	1,408
Jay	1,408
Jefferson	1,408
Jennings	1,408
Johnson	1,408
Knox	1,408
Kosciusko	1,408
Lagrange	1,408
Lake	2,500
Laporte	1,408
Lawrence	1,408
Madison	1,408
Marion	2,500
Marshall	1,408
Martin	1,408
Miami	1,408
Monroe	1,408
Montgomery	1,408
Morgan	1,408
Newton	1,408
Noble	1,408
Ohio	800
Orange	1,408
Owen	1,408
Parke	1,408
Perry	1,408
Pike	1,408
Porter	1,408
Posey	1,408
Pulaski	1,408
Putnam	1,408
Randolph	1,408
Ripley	1,408
Rush	1,408
Scott	1,000
Shelby	1,408
Spencer	1,408
Starke	1,408
St. Joseph	2,500
Steuben	1,408
Sullivan	1,408
Switzerland	1,408
Tippecanoe	1,408
Tipton	1,408
Union	1,325
Vanderburg	1,408
Vermilion	1,408
Vigo	2,500
Wabash	1,408
Warren	1,408
Warrick	1,408
Washington	1,408
Wayne	1,408
Wells	1,408
White	1,408
Whitley	1,408
Average for 92 counties	1,449

City.	Superintendent.	Assistant.
Crown Point	$1,700	
Decatur	1,500	
Dunkirk	1,200	
East Chicago		
Elkhart	2,400	
Elwood	1,800	
Evansville	4,200	
Fairmount	1,200	
Fort Wayne	4,200	$1,900
Frankfort	2,100	
Franklin	1,650	
Garrett	1,500	1,000
Gary	6,000	[1] 4,000
Gas City	1,524	
Goshen	2,700	
Greencastle	2,000	
Greenfield	1,500	
Hammond	4,000	
Hartford City	1,800	
Huntington	2,400	
Indianapolis	5,500	[2] 4,000
Jasonville	1,100	
Jeffersonville	1,800	
Kendallville	2,000	
Kokomo	2,400	
La Fayette	3,000	
Laporte City	2,400	
Lawrenceburg	1,800	
Lebanon	2,000	
Linton	1,500	
Logansport	2,500	
Madison	1,800	
Marion	2,500	
Martinsville	2,000	1,300
Michigan City	2,800	
Mishawaka	2,400	
Mitchell	2,475	
Montpelier	1,500	
Mount Vernon	2,000	
Muncie	3,000	
New Albany	2,400	
Newcastle	2,400	
Noblesville	1,500	
Peru	2,000	
Portland	1,800	
Plymouth	1,800	
Princeton	2,200	
Richmond	3,100	
Rochester	1,890	
Rockport	1,410	
Rushville	1,800	
Seymour	2,000	
Shelbyville	2,500	
South Bend	3,800	
Sullivan	1,600	
Tell City	1,250	
Terre Haute	3,200	2,400
Tipton	1,500	
Union City	1,800	
Valparaiso	2,400	
Vincennes	3,000	
Wabash	1,900	
Warsaw	1,500	
Washington	2,000	
West Lafayette	1,700	
West Terre Haute	1,380	
Whiting	3,000	
Winchester	1,800	
Average for 73 cities	2,542	

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[1] One additional at $2,400.

[2] One additional at $3,100; one at $2,600.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

IOWA.

County.	Superintendent.	City.	Superintendent.	Assistant.
Adair	$1,500	Albia	$1,800	$1,000
Adams	1,500	Algona	2,000	....
Allamakee	1,500	Ames	2,100	....
Appanoose	1,500	Anamosa	1,700	....
Audubon	1,500	Atlantic	1,950	....
Benton	1,500	Belle Plaine	1,800	....
Black Hawk	2,000	Boone	2,400	1,750
Boone	1,500	Burlington	3,000	....
Bremer	1,500	Carroll	2,000	1,350
Buchanan	1,500	Cedar Falls	2,400	....
Buena Vista	1,500	Cedar Rapids	3,500	....
Butler	1,500	Centerville	2,000	....
Calhoun	1,500	Chariton	1,575	....
Carroll	1,500	Charles City	2,100	....
Cass	1,500	Cherokee	2,000	....
Cedar	1,500	Clarinda	2,000	....
Cerro Gordo	2,000	Clinton	3,000	....
Cherokee	1,500	Colfax	1,800	....
Chickasaw	1,500	Council Bluffs	3,500	....
Clarke	1,500	Cresco	1,650	1,000
Clay	1,500	Creston	1,800	....
Clayton	1,500	Davenport	4,200	....
Clinton	1,600	Decorah	2,100	....
Crawford	1,500	Denison	2,000	1,500
Dallas	1,500	Des Moines	5,000	2,500
Davis	1,500	Dubuque	4,000	....
Decatur	1,500	Eagle Grove	1,650	....
Delaware	1,500	Esterville	2,400	....
Des Moines	1,500	Fairfield	1,800	....
Dickinson	1,500	Fort Dodge	3,000	....
Dubuque	1,500	Fort Madison	2,000	1,500
Emmett	1,500	Glenwood	1,500	....
Fayette	1,500	Grinnell	2,000	....
Floyd	1,500	Hampton	1,900	....
Franklin	1,500	Harlan	1,700	....
Fremont	1,500	Hawkeye	810	....
Greene	1,500	Independence	2,000	....
Grundy	1,500	Indianola	2,000	....
Guthrie	1,500	Iowa City	2,500	....
Hamilton	1,500	Iowa Falls	1,900	....
Hancock	1,500	Keokuk	2,400	....
Hardin	1,500	Knoxville	1,800	....
Harrison	1,500	Le Mars	2,100	....
Henry	1,500	Manchester	1,600	....
Howard	1,500	Maquoketa	1,500	....
Humboldt	1,500	Marion	1,600	....
Ida	1,680	Marshalltown	2,500	....
Iowa	1,500	Mason City	2,600	....
Jackson	1,500	Missouri Valley	2,100	....
Jasper	1,500	Mount Pleasant	1,800	....
Jefferson	1,500	Muscatine	1,900	1,750
Johnson	1,500	Mystic	1,300	....
Jones	1,500	Newton	2,400	....
Keokuk	1,500	Oelwein	2,000	....
Kossuth	1,500	Oskaloosa	2,300	....
Lee	1,500	Ottumwa	3,300	....
Linn	2,250	Pella	1,700	....
Louisa	1,500	Perry	2,100	....
Lucas	1,500	Red Oak	2,000	....
Lyon	1,500	Sheldon	2,000	1,200
Madison	1,500	Shenandoah	2,280	....
Mahaska	1,500	Sioux City	5,000	....
Marion	1,500	Spencer	1,900	....
Marshall	1,500	Valley Junction	1,400	....
Mills	1,600	Vinton	1,800	....
Mitchell	1,500	Washington	1,700	....
Monona	1,500	Waterloo:		
Monroe	1,500	East Side	2,850	1,850
Montgomery	1,500	West Side	2,600	1,950
Muscatine	1,500	Waverly	2,000	....
O'Brien	1,500	Webster City	2,400	....
Osceola	1,500	Winterset	1,500	....
Page	1,500			
Palo Alto	1,500	Average for 71 cities	2,211	....
Plymouth	1,500			
Pocahontas	1,500			
Polk	2,000			
Pottawattamie	1,500			
Poweshiek	1,500			

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

IOWA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Ringgold	$1,500			
Sac	1,500			
Scott	1,800			
Shelby	1,500			
Sioux	2,000			
Story	1,500			
Tama	1,500			
Taylor	1,500			
Union	1,500			
Van Buren	1,500			
Wapello	1,500			
Warren	1,500			
Washington	1,500			
Wayne	1,500			
Webster	1,500			
Winnebago	1,500			
Winneshiek	1,800			
Woodbury	2,000			
Worth	1,500			
Wright	1,800			
Average for 99 counties	1,546			

KANSAS.

County.	Superintendent.	City.	Superintendent.	Assistant.
Allen	$1,200	Abilene	$1,800	....
Anderson	1,200	Anthony	1,600	....
Atchison	1,200	Arkansas City	2,000	....
Barber	1,100	Atchison	2,000	....
Barton	1,200	Beloit	1,700	....
Bourbon	1,200	Caney	1,800	....
Brown	1,200	Chanute	2,300	....
Butler	1,200	Cherryvale	1,700	....
Chase	1,000	Clay Center	1,500	....
Chautauqua	1,200	Coffeyville	2,400	....
Cherokee	1,200	Columbus	1,300	....
Cheyenne	750	Concordia	2,000	....
Clark	750	Council Grove	1,450	....
Clay	1,200	Dodge	2,000	....
Cloud	1,200	Eldorado	1,700	....
Coffey	1,200	Emporia	2,400	....
Comanche	750	Fort Scott	2,200	....
Cowley	1,200	Fredonia	1,600	....
Crawford	1,800	Frontenac	1,500	....
Decatur	1,000	Galena	1,600	....
Dickinson	1,200	Garden	1,800	....
Doniphan	1,200	Great Bend	2,000	$1,200
Douglas	1,200	Herington	1,500	....
Edwards	1,000	Hiawatha	1,800	....
Elk	1,100	Holton	1,500	....
Ellis	1,200	Horton	1,600	....
Ellsworth	1,100	Humboldt	1,700	....
Finney	820	Hutchinson	2,500	....
Ford	1,100	Independence	3,600	....
Franklin	1,200	Iola	2,000	....
Geary	1,000	Junction City	1,950	....
Gove	800	Kansas City	3,500	....
Graham	1,000	Kingman	1,600	....
Grant	540	Larned	1,575	....
Gray	800	Lawrence	2,500	....
Greeley	540	Leavenworth	3,000	....
Greenwood	1,200	Manhattan	2,200	....
Hamilton	600	McPherson	1,500	....
Harper	1,200	Neodesha	2,000	....
Harvey	1,200	Newton	2,200	....
Haskell	540	Olathe	1,550	....
Hodgeman	600	Ottawa	2,100	....
Jackson	1,200	Paloa	1,500	....
Jefferson	1,200	Parsons	2,000	....
Jewell	1,200	Pittsburg	2,600	....
Johnson	1,200	Pratt	1,650	....
Kearny	600	Rosedale	1,700	....
Kingman	1,200	Salina	3,000	....
Kiowa	1,000	Topeka	4,800	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

KANSAS—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Labette	$1,200	Wellington	$1,200	....
Lane	600	Wichita	3,250	....
Leavenworth	1,200	Winfield	2,500	....
Lincoln	1,100			
Linn	1,200	Average for 52 cities	2,047	....
Logan	600			
Lyon	1,200			
Marion	1,200			
Marshall	1,200			
McPherson	1,200			
Meade	860			
Miami	1,200			
Mitchell	1,200			
Montgomery	1,200			
Morris	1,100			
Morton	600			
Nemaha	1,200			
Neosho	1,200			
Ness	1,000			
Norton	1,100			
Osage	1,200			
Osborne	1,200			
Ottawa	1,100			
Pawnee	1,000			
Phillips	1,200			
Pottawatomie	1,200			
Pratt	1,100			
Rawlins	900			
Reno	1,200			
Republic	1,200			
Rice	1,200			
Riley	1,200			
Rooks	1,200			
Rush	1,000			
Russell	1,200			
Saline	1,200			
Scott	600			
Sedgwick	1,800			
Seward	600			
Shawnee	1,800			
Sheridan	800			
Sherman	800			
Smith	1,200			
Stafford	1,200			
Stanton	540			
Stevens	600			
Sumner	1,200			
Thomas	800			
Trego	800			
Wabaunsee	1,200			
Wallace	600			
Washington	1,200			
Wichita	540			
Wilson	1,200			
Woodson	1,000			
Wyandotte	1,800			
Average for 105 counties	1,061			

KENTUCKY.

County.	Superintendent.	City.	Superintendent.	Assistant.
Adair	$700	Ashland	$2,500	....
Allen	750	Bellevue	2,000	....
Anderson	600	Bowling Green	2,000	....
Ballard	1,000	Catlettsburg	1,500	....
Barren	1,411	Central City	1,400	....
Bath	750	Corbin	1,300	....
Bell	1,200	Covington	3,500	....
Boone	700	Cynthiana	2,000	....
Bourbon	1,000	Danville	1,600	....
Boyd	1,250	Dayton	1,250	$1,000
Boyle	900	Earlington	1,500	....
Bracken	750	Frankfort	2,000	....
Breathitt	1,500	Franklin	1,800	800
Breckinridge	1,250	Fulton	1,500	....
Bullitt	675	Georgetown	1,800	....
Butler	800	Henderson	2,100	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

KENTUCKY—Continued.

County.	Superintendent.
Caldwell	$750
Calloway	971
Campbell	1,000
Carlisle	750
Carroll	600
Carter	1,200
Casey	1,000
Christian	1,800
Clark	1,000
Clay	1,140
Clinton	400
Crittenden	700
Cumberland	638
Daviess	1,500
Edmonson	600
Elliott	600
Estill	678
Fayette	1,800
Fleming	800
Floyd	1,296
Franklin	1,200
Fulton	881
Gallatin	700
Garrard	650
Grant	1,000
Graves	1,500
Grayson	750
Green	900
Greenup	600
Hancock	600
Hardin	1,450
Harlan	1,200
Harrison	1,000
Hart	110
Henderson	1,500
Henry	800
Hickman	1,000
Hopkins	1,500
Jackson	800
Jefferson	2,500
Jessamine	800
Johnson	900
Kenton	1,200
Knott	900
Knox	1,200
Larue	920
Laurel	900
Lee	600
Leslie	600
Letcher	1,000
Lewis	800
Lincoln	1,000
Livingston	650
Logan	1,200
Lyon	600
Madison	1,250
Magoffin	650
Marion	800
Marshall	625
Martin	600
Mason	900
McCracken	1,000
McCreary	850
McLean	600
Meade	800
Menifee	550
Mercer	900
Metcalfe	750
Monroe	571
Montgomery	700
Morgan	900
Muhlenberg	1,200
Nelson	800
Nicholas	650
Ohio	1,000
Oldham	600
Owen	1,000
Owsley	600
Pendleton	800

City.	Superintendent.	Assistant.
Hickman	$1,500	....
Hopkinsville	2,400	....
Lebanon	1,500	....
Lexington	2,800	....
Louisville	5,000	....
Ludlow	1,400	....
Madisonville	1,500	....
Mayfield	1,600	....
Maysville	2,000	....
Middlesboro	2,000	$800
Morganfield	1,450	....
Mount Sterling	1,800	1,000
Newport	2,500	....
Nicholasville	1,575	....
Owensboro	2,520	....
Paducah	2,500	....
Paris	2,400	....
Princeton	1,200	1,000
Richmond	1,800	....
Russellville	1,500	....
Shelbyville	1,800	....
Somerset	2,500	....
Winchester	1,500	....
Average for 39 cities	**1,964**	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

KENTUCKY—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Perry	$750			
Pike	1,800			
Powell	600			
Pulaski	1,200			
Robertson	600			
Rockcastle	800			
Rowan	600			
Russell	600			
Scott	150			
Shelby	1,050			
Simpson	600			
Spencer	600			
Taylor	500			
Todd	1,020			
Trigg	959			
Trimble	600			
Union	1,200			
Warren	1,100			
Washington	800			
Wayne	956			
Webster	1,200			
Whitley	1,600			
Wolfe	900			
Woodford	600			
Average for 120 counties	944			

LOUISIANA.

Parish.	Superintendent.	Assistant.	City.	Superintendent.[1]	Assistant.
Acadia	$1,500	....	Abbeville	$1,440	$720
Allen	2,167	....	Alexandria	2,500	....
Ascension	1,800	....	Baton Rouge	1,800	....
Assumption	1,800	....	Bogalusa	2,100	....
Avoyelles	1,800	....	Crowley	1,800	....
Baton Rouge:			Donaldsonville	1,260	....
East	1,735	....	Hammond	1,700	....
West	1,500	....	Houma	1,800	....
Beauregard	2,469	....	Jennings	1,600	....
Bienville	1,771	....	Kentwood	1,350	....
Bossier	1,200	....	Lafayette	1,450	....
Caddo	3,600	$1,800	Lake Charles	2,700	....
Calcasieu	3,000	1,800	Minden	1,500	....
Caldwell	900	....	Monroe	2,000	....
Cameron	800	....	Morgan	1,700	....
Carroll:			New Orleans	5,000	[2] 3,300
East	1,750	....	Patterson	1,400	990
West	1,500	....	Plaquemine	1,215	....
Catahoula	1,350	....	Ruston	1,500	....
Claiborne	1,200	....	Shreveport	3,600	1,800
Concordia	1,500	....	Thibodaux	2,100	....
De Soto	1,779	....	Winnfield	1,400	800
Evangeline	1,500	....			
Feliciana:			Average for 22 cities	1,951	....
East	1,200	....			
West	1,250	....			
Franklin	1,200	....			
Grant	1,500	....			
Iberia	1,800	....			
Iberville	2,100	....			
Jackson	1,500	....			
Jefferson	2,000	....			
Jefferson Davis	1,800	....			
Lafayette	2,450	....			
Lafourche	2,100	....			
La Salle	1,200	....			
Lincoln	1,500	....			
Livingston	1,200	....			
Madison	1,600	....			
Morehouse	1,575	....			

[1] With the exception of Lake Charles and New Orleans all others are supervising principals, as the cities are under the parish boards of education.

[2] One additional at $2,700.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

LOUISIANA—Continued.

Parish.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Natchitoches	$2,000	....			
Orleans	5,000	....			
Ouachita	2,600	....			
Plaquemines	1,200	....			
Pointe Coupee	1,999	....			
Rapides	2,500	....			
Red River	1,475	....			
Richland	1,500	....			
Sabine	1,200	....			
St. Bernard	1,800	....			
St. Charles	1,200	....			
St. Helena	550	....			
St. James	1,625	....			
St. Johns	1,438	....			
St. Landry	1,823	....			
St. Martin	1,650	....			
St. Mary	1,650	....			
St. Tammany	1,800	....			
Tangipahoa	1,350	....			
Tensas	1,500	....			
Terrebonne	1,800	....			
Union	1,625	....			
Vermilion	1,375	....			
Vernon	2,500	....			
Washington	1,150	....			
Webster	1,800	....			
Winn	1,375	....			
Average for 64 parishes	1,711	....			

MAINE.

Supervisory union.[1]	Superintendent.	City.	Superintendent.
Abbot, Blanchard, Guilford, Monson, Willimantic	$1,400	Auburn	$2,300
Addison, Jonesboro, Jonesport	1,250	Augusta	2,100
Albion, Troy, Unity	1,200	Bangor	2,500
Alfred, Sanford	1,600	Bath	1,600
Anson, Embden, Lexington, New Portland	1,200	Biddeford	2,200
Argyle, Greenfield, Bradley, Greenbush, Milford, Passadumkeag	900	Ellsworth	1,600
Ashland, Garfield, Masardis, Nashville, Portage Lake	1,300	Lewiston	2,500
Athens, Cornville, Harmony, Solon	1,250	Portland	3,050
Bancroft, Danforth, Orient, Reed Pl., Weston	1,200	Saco	1,550
Beddington, Cherryfield, Columbia Falls, Deblois	900	Waterville	2,000
Belfast, Searsport	1,600	Average for 10 cities	2,140
Belgrade, Mount Vernon, Readfield	1,205		
Benton, Winslow	1,500		
Berwick, Lebanon	1,200		
Bethel, Greenwood	1,200		
Blaine, Bridgewater, Mars Hill	1,200		
Bluehill, Brooklin, Sedgwick	1,400		
Boothbay, Boothbay Harbor, Monhegan	1,400		
Bowdoin, Litchfield, Wales, West Gardiner	1,100		
Bowdoinham, Richmond	1,200		
Bradford, Charleston, Corinth, Kenduskeag	1,300		
Brewer, Hampden, Veazie	1,600		
Bridgton, Harrison	1,200		
Brooksville, Castine, Penobscot	1,200		
Brownfield, Cornish, Parsonsville, Porter	1,250		
Brownville, Milo	1,600		
Brunswick, Topsham	2,000		
Buckfield, Hartford, Hebron	1,300		
Burnham, Canaan, Clinton	1,200		
Buxton, Standish	1,200		
Camden, Thomaston	1,725		
Canton, Turner	1,200		
Cape Elizabeth, South Portland	1,600		

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[1] Names of towns in supervisory unions.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MAINE—Continued.

Supervisory union.[1]	Superintendent	City.	Superintendent.
Caratunk, Concord, Moscow, The Forks, West Forks	$1,020		
Caribou, Limestone	1,700		
Castle Hill, Mapleton, Wade, Washburn	1,300		
Chapman, Presque Isle	1,700		
Chester, Kingman, Lee, Macwahoc, Mattawamkeag, Winn	1,200		
China, Vassalboro	1,200		
Columbia, Harrington, Milbridge, Steuben	1,200		
Corinna, Newport, Plymouth	1,500		
Crystal, Island Falls, Sherman	1,300		
Cumberland, Falmouth, North Yarmouth	1,200		
Damariscotta, Newcastle, South Bristol	495		
Dayton, Saco	1,550		
Deer Isle, Isle au Haut, Stonington	1,300		
Dexter, Garland	1,563		
Dover, Foxcroft	1,200		
East Livermore, Wayne	1,200		
East Machias, Machias, Machiasport, Marshfield, Roque Bluffs, Whitneyville	1,300		
East Millinocket, Hersey, Millinocket, Mount Chase, Patten	1,750		
Easton, Fort Fairfield	1,800		
Eastport, Lubec	1,550		
Eddington, Holden, Orrington	1,200		
Eden, Hancock	2,200		
Eloit, South Berwick	1,300		
Fairfield, Oakland	1,500		
Farmingdale, Gardiner	1,800		
Farmington, Wilton	1,200		
Fort Kent, New Canada, St. Francis, St. John, Wallagras	1,225		
Frankfort, Monroe, Winterport	1,200		
Freeport, Yarmouth	1,400		
Frenchville, Grand Isle, Madawaska, St. Agatha	1,350		
Gorham, Westbrook	2,000		
Gouldsboro, Sorrento, Sullivan, Winter Harbor	1,200		
Greenville, Jackman, Moose River, Sangerville	1,500		
Hallowell, Winthrop	1,510		
Hanover, Rumford	1,900		
Hartland, Palmyria, St. Albans	1,200		
Hodgdon, Houlton	1,800		
Hollis, Waterboro	1,200		
Kennebunk, Kennebunkport	1,400		
Jay, Livermore	1,500		
Lisbon, Webster	1,500		
Madison, Skowhegan	1,800		
Mount Desert, Southwest Harbor, Tremont	1,700		
New Sweden, Stockholm, Westmoreland, Woodland	1,200		
North Berwick, Wells	1,400		
Norway, Waterford	1,500		
Oldtown, Orono	2,100		
Paris, Woodstock	1,375		
Raymond, Windham	1,200		
Rockland, Rockport	2,000		
Swans Island, Vinalhaven	1,140		
Average for 84 supervisory unions	1,393		

MARYLAND.[2]

County.	Superintendent.	City.	Superintendent.	Assistant.
Allegany	$3,000	Annapolis	$2,000	
Anne Arundel	2,000	Baltimore	5,000	[3] $3,200
Baltimore	5,000	Bel Air	1,500	
Calvert	1,800	Brunswick	1,500	
Caroline	1,800	Chestertown	1,400	
Carroll	2,000	Crisfield	1,400	

[1] Names of towns in supervisory unions.

[2] All given as city superintendents, except Baltimore, are supervising principals.

[3] One additional at $2,700 and 4 at $2,500.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MARYLAND—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Cecil	$1,800	Cumberland	$1,600	....
Charles	1,800	Denton	1,200	....
Dorchester	1,800	Easton	1,400	....
Frederick	2,000	Elkton	1,400	....
Garrett	2,000	Frederick	1,800	....
Harford	1,800	Frostburg	1,600	....
Howard	2,000	Hagerstown	1,400	....
Kent	1,800	Havre de Grace	1,500	....
Montgomery	1,800	Pocomoke City	1,400	....
Prince Georges	2,000	Reistertown	1,800	....
Queen Annes	2,500	Salisbury	1,400	....
St. Marys	1,800	Towson	1,800	....
Somerset	1,800	Westernport	1,450	....
Talbot	1,800	Westminster	1,300	....
Washington	3,000			
Wicomico	3,000	Average for 20 cities	1,687	....
Worcester	2,000			
Average for 23 counties	2,187			

MASSACHUSETTS.

Union district.[1]	Superintendent.	City.	Superintendent.	Assistant.
Acton, Carlisle, Littleton, Westford	$2,100	Adams	$2,500	....
Alford, Egremont, Richmond, West Stockbridge.	1,600	Amesbury	1,750	....
		Andover	2,400	....
Amherst, Pelham	2,800	Arlington	2,500	....
Ashby, Lunenburg, Townsend	1,750	Athol	2,200	....
Ashfield, Cummington, Goshen, Plainfield.	1,600	Attleboro	2,500	....
		Barnstable	1,800	....
Ashland, Hopkinton	1,500	Beverly	2,850	....
Auburn, Sutton	1,500	Boston	10,000	[2] $5,496
Ayer, Boylston, Shirley, West Boylston	2,000	Braintree	2,000	....
Barre, Hardwick, Petersham	1,700	Brockton	3,600	....
Becket, Chester, Middlefield	1,700	Brookline	4,500	....
Belmont, Burlington	2,650	Cambridge	5,000	[3] 1,500
Belchertown, Enfield	1,500	Canton	2,000	....
Bellingham, Hopedale, Mendon	2,050	Chelmsford	1,700	....
Berkley, Dighton, Rehoboth	1,600	Chelsea	3,000	....
Berlin, Northboro, Shrewsbury, Southboro.	1,800	Chicopee	3,000	....
		Clinton	2,100	....
Bernardstown, Hadley, Hatfield	1,800	Concord	2,500	....
Blandford, Huntington, Montgomery, Russell.	1,500	Dalton	1,800	....
		Danvers	2,200	....
Bolton, Dunstable, Harvard, Pepperell	1,900	Dartmouth	1,700	....
Bourne, Mashpee, Sandwich	1,900	Dedham	2,400	....
Boxborough, Maynard, Stow	1,800	Cohassett	2,000	....
Boxford, Georgetown, Groveland, Rowley	1,700	East Weymouth	2,200	....
Brewster, Dennis, Yarmouth	1,600	Easton	2,400	....
Brookfield, North Brookfield	1,500	Everett	3,000	1,100
Buckland, Colrain, Shelburne	1,500	Fall River	4,000	2,500
Carver, Lakeville, Raynham, Rochester	2,000	Falmouth	2,200	....
Charlemont, Hawley, Heath, Rowe	1,500	Fitchburg	3,500	....
Charlton, Leicester	1,600	Framingham	3,000	....
Chatham, Eastham, Harwick, Orleans	2,000	Gardner	2,300	....
Cheshire, Hancock, Lanesboro, New Ashford.	1,600	Gloucester	2,300	....
		Great Barrington	3,000	....
Chesterfield, Williamsburg, Worthington	1,500	Greenfield	2,300	....
Chilmark, Edgartown, Gay Head, Oak Bluffs, Tisbury, West Tisbury.	1,900	Haverhill	3,500	....
		Holyoke	3,375	....
Clarksburg, Florida, Monroe, Savoy	1,500	Ipswich	1,700	....
Conway, Deerfield, Sunderland, Whatly	1,700	Lawrence	3,500	1,900
Dana, Greenwich, New Salem, Prescott	1,500	Lancaster	2,000	....
Douglas, Uxbridge	1,700	Lenox	1,800	....
Dover, Sudbury, Wayland	1,600	Leominster	2,600	....
Dracut, North Reading, Tewksbury, Tyngsborough.	2,300	Lexington	2,500	....
		Lowell	3,000	....
Duxbury, Marshfield, Scituate	1,900	Lynn	3,250	1,900
East Bridgewater, West Bridgewater	1,800	Malden	2,900	....

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[1] Names of towns in union districts.
[2] Four additional at $1,775.
[3] One additional at $1,140 and one at $1,096.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MASSACHUSETTS—Continued.

Union district.	Superintendent.
East Longmeadow, Hampden, Longmeadow, Wilbraham.	$1,650
Erving, Leverett, Shutesbury, Wendell	1,550
Essex, Lynnfield, Middleton, Topsfield, Wenham.	2,000
Foxboro, Norton, Plainville	1,800
Freetown, Westport	1,800
Gill, Leyden, Northfield, Warwick	1,800
Granville, Sandisfield, Southwick, Tolland.	1,700
Halifax, Kingston, Pembroke, Plympton.	1,650
Hanover, Hanson, Norwell	1,700
Hinsdale, Peru, Washington, Windsor	1,600
Holden, Oakham, Paxton, Rutland	1,500
Holliston, Medway, Sherborn	1,750
Hubbardston, Phillipston, Royalston, Templeton.	1,800
Medfield, Millis, Norfolk, Westwood	1,800
Merrimac, Newbury, Salisbury, West Newbury.	1,700
Mount Washington, New Marlboro, Sheffield.	1,600
New Braintree, Sturtbridge, Brookfield	1,500
Princeton, Sterling, Westminster	1,600
Provincetown, Truro, Wellfleet	1,600
Somerset, Swansea	1,800
Stoneham, Bedford	2,400
Wilmington, Boxford, Middleton	2,800
Webster, Dudley, Upton, Grafton	1,800
Average for 62 union districts	1,775

City.	Superintendent.	Assistant.
Manchester	$1,800	
Marblehead	2,000	
Marlboro	2,300	
Medford	3,150	1,000
Melrose	3,000	
Methuen	2,200	
Middleboro	2,400	
Milford	2,100	
Milton	3,300	
Montague	2,000	
Nantucket	1,500	
Natick	2,000	
Needham	2,400	
New Bedford	4,000	2,400
Newburyport	2,200	
Newton	4,500	2,350
Nahant	1,700	
North Adams	2,500	
North Andover	2,200	
North Attleboro	2,300	
Northampton	3,000	
Northbridge	2,500	
Norwood	2,200	
Orange	1,700	
Palmer	2,200	
Peabody	2,300	
Pittsfield	3,000	
Plymouth	2,300	
Quincy	3,000	
Reading	3,000	
Revere	2,650	
Rockland	1,700	
Rockport	1,400	
Salem	3,050	
Saugus	2,000	
Somerville	3,500	
Southbridge	2,250	
Spencer	2,000	
Springfield	5,000	3,000
Stockbridge	1,800	
Swampscott	2,300	
Taunton	2,800	
Wakefield	2,300	
Walpole	2,150	
Waltham	2,500	
Ware	2,100	
Watertown	2,200	
Wellesley	2,800	
Westboro	1,800	
Weston	2,400	
Westfield	2,600	
West Springfield	2,500	
Weymouth	2,300	
Whitman	2,000	
Williamstown	1,200	
Winchester	2,950	
Winthrop	2,700	
Woburn	2,400	
Worcester	4,500	[1] 3,000
Average for 105 cities	2,609	

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[1] Two additional at $3,000 each.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MICHIGAN.

County.	Superintendent.	City.	Superintendent.	Assistant.
Alcona	$500	Adrian	$2,500	....
Alger	750	Albion	1,900	$1,100
Allegan	2,000	Allegan	1,900	....
Alpena	1,000	Alma	1,900	....
Antrim	1,200	Alpena	1,800	....
Arenac	750	Ann Arbor	3,000	....
Baraga	650	Battle Creek	3,500	2,000
Barry	1,500	Bay City	3,750	....
Bay	1,500	Belding	....	....
Benzie	750	Benton Harbor	2,750	....
Berrien	2,000	Bessemer	2,800	....
Branch	1,200	Big Rapids	1,850	....
Calhoun	2,000	Boyne City	2,000	....
Cass	1,200	Cadillac	2,050	....
Charlevoix	1,200	Calumet	4,500	....
Cheboygan	1,200	Charlotte	2,000	....
Chippewa	1,500	Cheboygan	1,500	....
Clare	1,100	Coldwater	2,000	....
Clinton	1,500	Crystal Falls	2,850	....
Crawford	300	Detroit	9,000	4,800
Delta	1,200	Dowagiac	2,000	....
Dickinson	1,350	East Jordan	1,600	....
Eaton	1,500	Escanaba	2,800	....
Emmet	1,200	Flint	3,600	....
Genesee	1,500	Gladstone	1,800	....
Gladwin	500	Grand Haven	1,900	....
Gogebic	600	Grand Ledge	1,600	....
Grand Traverse	1,200	Grand Rapids	4,500	2,500
Gratiot	1,500	Greenville	2,000	....
Hillsdale	1,500	Hamtramck	2,500	....
Houghton	2,200	Hancock	....	....
Huron	1,500	Hastings	2,400	....
Ingham	1,500	Highland Park	4,000	....
Ionia	1,500	Hillsdale	2,000	....
Iosco	1,000	Holland	....	....
Iron	1,800	Houghton	3,500	....
Isabella	1,400	Ionia	2,000	....
Jackson	2,000	Iron Mountain	2,750	....
Kalamazoo	1,500	Ironwood	3,100	....
Kalkaska	1,000	Ishpeming	3,600	....
Kent	2,000	Jackson	4,000	2,500
Keweenaw	400	Kalamazoo	3,500	....
Lake	550	Lansing	2,400	....
Lapeer	1,400	Lapeer	1,700	....
Leelanau	700	Ludington	1,900	....
Lenawee	1,500	Manistee	2,700	....
Livingston	1,350	Manistique	2,200	....
Luce	250	Marine City	1,750	....
Mackinac	1,000	Marquette	2,400	....
Macomb	1,600	Marshall	1,700	....
Manistee	1,000	Menominee	2,900	....
Marquette	1,800	Midland	1,500	1,200
Mason	1,200	Monroe	2,500	1,650
Mecosta	1,200	Mount Clemens	2,300	....
Menominee	1,740	Mount Pleasant	1,900	....
Midland	1,200	Munising	1,850	....
Missaukee	1,100	Muskegon	4,000	....
Monroe	1,500	Negaunee	2,300	....
Montcalm	1,500	Niles	2,200	....
Montmorency	600	Norway	1,850	....
Muskegon	1,200	Onaway	1,500	....
Newaygo	1,200	Otsego	1,600	....
Oakland	1,500	Owosso	2,500	....
Oceana	1,200	Petoskey	....	....
Ogemaw	500	Pontiac	3,000	1,000
Ontonagon	1,000	Port Huron	2,650	....
Osceola	1,200	River Rouge	1,800	....
Oscoda	250	Saginaw:		
Otsego	500	East Side	3,600	....
Ottawa	1,500	West Side	2,800	....
Presque Isle	750	St. Clair	1,550	....
Roscommon	450	St. Johns	1,700	1,200
Saginaw	2,000	St. Joseph	5,400	....
St. Clair	2,000	Sault Ste. Marie	2,600	....
St. Joseph	1,500	South Haven	1,700	....
Sanilac	1,500	Sturgis	2,000	....
Schoolcraft	1,100	Three Rivers	....	....
Shiawassee	1,500	Traverse City	2,700	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MICHIGAN—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Tuscola	$1,500	Wyandotte	$2,000	....
Van Buren	1,500	Ypsilanti	2 500	....
Washtenaw	1,800			
Wayne	2,500	Average for 74 cities	2,572	....
Wexford	1,000			
Average for 83 counties	1,253			

MINNESOTA.

County.	Superintendent.	City.	Superintendent.	Assistant.
Aitkin	$1,775	Albert Lea	$2,800	$1,200
Anoka	1,200	Alexandria	1,900	....
Becker	1,525	Anoka	1,700	....
Beltrami	1,700	Austin	2,500	....
Benton	1,100	Bemidji	2,600	....
Bigstone	1,200	Brainerd	2,400	....
Blue Earth	2,282	Chisholm	4,500	....
Brown	1,800	Cloquet	2,600	....
Carlton	1,200	Crookston	2,700	....
Carver	1,500	Detroit	2,250	....
Cass	1,800	Duluth	2,000	....
Chippewa	1,450	East Grand Forks	2,100	....
Chisago	1,000	Ely	3,100	....
Clay	1,800	Eveleth	4,000	....
Clearwater	1,005	Fairmont	2,000	....
Cook	500	Faribault	2,500	....
Cottonwood	1,200	Fergus Falls	2,200	....
Crow Wing	1,450	Hastings	1,500	920
Dakota	1,200	Hibbing	4,200	3,120
Dodge	1,075	Hopkins	2,000	....
Douglas	1,800	Lake City	1,800	1,050
Faribault	1,625	Little Falls	2,200	....
Fillmore	2,000	Luverne	2,100	....
Freeborn	1,662	Mankato	2,300	....
Goodhue	2,200	Melrose	1,800	....
Grant	1,200	Minneapolis	8,000	[1] 4,000
Hennepin	2,000	Montevideo	2,000	....
Houston	1,337	Moorhead	2,200	....
Hubbard	1,200	New Ulm	2,300	....
Isanti	1,100	Northfield	2,200	....
Itasca	1,200	Owatonna	2,400	....
Jackson	1,800	Red Wing	2,200	....
Kanabec	900	Rochester	3,000	1,800
Kandiyohi	1,900	St. Cloud	3,000	....
Kittson	1.200	St. Paul	5,000	[2] 3,250
Koochiching	1,500	St. Peter	2,100	....
Lac qui Parle	1,700	South St. Paul	2,000	....
Lake	480	Staples	1,800	....
Lesueur	1,412	Stillwater	2,300	....
Lincoln	1,100	Thief River Falls	2,400	....
Lyon	1,300	Two Harbors	2,600	....
McLeod	1,500	Virginia	4,500	....
Mahnomen	800	Wabasha	1,850	....
Marshall	2,000	Waseca	2,000	....
Martin	1,600	West Minneapolis	2,000	....
Meeker	1,150	West St. Paul	1,200	....
Millelacs	1,110	Willmar	2,100	1,035
Morrison	1,900	Winona	2,500	2,000
Mower	1,725			
Murray	1,800	Average for 48 cities	2,575	....
Nicollet	1,000			
Nobles	1,700			
Norman	1,425			
Olmsted	2,100			
Ottertail	1,500			
Pennington	1,000			
Pine	1,743			
Pipestone	1,260			
Polk	1,500			
Pope	1,225			
Ramsey	2,750			
Red Lake	1,000			
Redwood	1,800			
Renville	1,767			
Rice	1,800			
Rock	1,500			
Roseau	1,625			

[1] One additional at $4,000, one at $3,000, and two at $2,900.

[2] One additional at $2,000.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MINNESOTA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
St. Louis	$2,500			
Scott	1,000			
Sherburne	800			
Sibley	1,500			
Stearns	2,400			
Steele	1,200			
Stevens	1,450			
Swift	1,250			
Todd	3,000			
Traverse	1,150			
Wabasha	1,500			
Wadena	1,800			
Waseca	1,162			
Washington	800			
Watonwan	915			
Wilkin	1,500			
Winona	1,800			
Wright	1,750			
Yellow Medicine	1,800			
Average for 86 counties	1,476			

MISSISSIPPI.[1]

County.	Superintendent.	City.	Superintendent.	Assistant.
Adams	$1,560	Aberdeen	$1,800	....
Alcorn	1,200	Bay St. Louis	1,200	....
Amite	....	Biloxi	1,800	$1,250
Attala	1,800	Brookhaven	1,800	1,000
Benton	....	Canton	1,850	....
Bolivar	1,800	Clarksdale	2,400	1,500
Calhoun	1,461	Collins	1,125	....
Carroll	1,800	Columbus	1,800	1,200
Chickasaw	1,194	Corinth	1,800	900
Choctaw	....	Grenada	1,500	900
Claiborne	1,200	Greenwood	2,400	....
Clarke	....	Greenville	2,250	....
Clay	....	Gulfport	2,250	1,350
Coahoma	1,800	Hattiesburg	2,400	....
Copiah	1,800	Houston	1,600	....
Covington	1,500	Jackson	3,000	....
De Soto	1,200	Laurel	2,500	1,125
Forrest	1,800	Moss Point	1,600	....
Franklin	....	Meridian	3,250	....
George	1,000	Natchez	2,250	1,350
Greene	1,200	Okolona	1,650	....
Grenada	....	Pascagoula	1,800	....
Hancock	....	Starkville	1,350	....
Harrison	1,800	Tupelo	1,800	850
Hinds	1,800	Vicksburg	2,300	....
Holmes	1,800	Water Valley	1,674	....
Issaguena	1,000	West Point	1,800	....
Itawamba	....	Yazoo City	2,000	....
Jackson	1,800			
Jasper	....	Average for 28 cities	1,962	....
Jefferson	1,800			
Jefferson Davis	....			
Jones	1,800			
Kemper	....			
Lafayette	1,700			
Lamar	....			
Lauderdale	1,800			
Lawrence	1,100			
Leake	1,200			
Lee	1,800			
Leflore	1,800			
Lincoln	1,800			
Lowndes	1,800			
Madison	1,800			
Marion	1,800			
Marshall	....			
Monroe	1,800			
Montgomery	1,200			
Neshoba	....			

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[1] In counties where no salaries are given the amount paid was unknown to the State department of education at the time the other figures were furnished to the bureau (Jan., 1917).

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MISSISSIPPI—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Newton	$1,200			
Noxubee	1,800			
Oktibbeha	....			
Panola	....			
Pearl River	1,800			
Perry	1,400			
Pike	....			
Pontotoc	1,200			
Prentiss	1,200			
Quitman	1,200			
Rankin	1,400			
Scott	1,500			
Sharkey	1,201			
Simpson	1,650			
Smith	1,800			
Stone	1,200			
Sunflower	1,800			
Tallahatchia	1,800			
Tate	1,800			
Tippah	....			
Tishomingo	....			
Tunica	....			
Union	1,200			
Walthall	....			
Warren	1,800			
Washington	1,800			
Wayne	1,433			
Webster	....			
Wilkinson	....			
Winston	1,165			
Yalobusha	....			
Yazoo	1,800			
Average for 56 counties	1,551			

MISSOURI.

County.	Superintendent.	City.	Superintendent.	Assistant.
Adair	$1,100	Aurora	$1,000	....
Andrew	1,000	Boonville	1,800	....
Atchison	900	Brookfield	1,600	....
Audrain	1,000	Butler	1,320	$1,000
Barry	1,200	Cameron	1,400	....
Barton	900	Cape Girardeau	2,100	....
Bates	1,100	Carterville	1,200	....
Benton	800	Carthage	2,400	....
Bollinger	800	Caruthersville	1,500	810
Boone	1,300	Charleston	1,500	....
Buchanan	1,500	Chillicothe	2,000	1,050
Butler	1,100	Clinton	2,020	....
Caldwell	900	Columbia	2,000	900
Callaway	1,100	De Soto	1,500	1,000
Camden	700	Eldorado Springs	1,250	....
Cape Girardeau	1,300	Excelsior Springs	2,000	....
Carroll	1,300	Farmington	1,400	....
Carter	700	Fayette	1,500	1,000
Cass	1,000	Festus	1,200	....
Cedar	900	Flat River	1,700	....
Chariton	1,000	Fredericktown	1,200	....
Christian	800	Fulton	1,500	....
Clark	900	Hannibal	2,700	....
Clay	900	Higginsville	1,350	....
Clinton	800	Independence	2,400	....
Cole	1,300	Jefferson City	2,300	....
Cooper	1,300	Joplin	3,000	....
Crawford	800	Kansas City	6,000	[1] 3,600
Dade	900	Kennett	1,500	1,000
Dallas	700	Kirksville	1,700	....
Daviess	1,000	Kirkwood	3,000	....
Dekalb	800	Lexington	1,800	1,100
Dent	800	Liberty	1,800	....
Douglas	700	Louisiana	1,350	....
Dunkin	1,100	Macon	1,700	....
Franklin	1,200	Maplewood	1,900	....
Gasconade	700	Marceline	1,200	....
Gentry	1,000	Marshall	1,800	....
Greene	1,500	Maryville	1,500	....
Grundy	1,000	Mexico	2,400	....

[1] Two additional at $2,500.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MISSOURI—Continued.

County.	Superintendent.
Harrison	$1,100
Henry	1,100
Hickory	700
Holt	900
Howard	800
Howell	1,000
Iron	700
Jackson	1,500
Jasper	1,500
Jefferson	1,300
Johnson	1,200
Knox	800
Laclede	900
Lafayette	1,400
Lawrence	1,300
Lewis	800
Lincoln	900
Linn	1,300
Livingston	1,200
McDonald	800
Macon	1,200
Madison	700
Maries	700
Marion	1,200
Mercer	700
Miller	900
Mississippi	700
Moniteau	900
Monroe	900
Montgomery	1,000
Morgan	800
New Madrid	900
Newton	1,200
Nodaway	1,400
Oregon	700
Osage	800
Ozark	700
Pemiscot	900
Perry	900
Pettis	1,400
Phelps	900
Pike	1,100
Platte	800
Polk	1,100
Pulaski	700
Putnam	800
Ralls	700
Randolph	1,100
Ray	1,000
Reynolds	700
Ripley	700
St. Charles	1,100
St. Clair	900
St. Francois	1,300
Ste.Genevieve	700
St. Louis	1,500
Saline	1,100
Schuyler	700
Scotland	800
Scott	1,000
Shannon	700
Shelby	800
Stoddard	1,100
Stone	700
Sullivan	1,100
Taney	700
Texas	900
Vernon	1,100
Warren	700
Washington	800
Wayne	800
Webster	1,000
Worth	700
Wright	900
Average for 114 counties	1,023

City.	Superintendent.	Assistant.
Moberly	$2,250	....
Monett	1,500	....
Neosho	1,125	....
Nevada	2,100	....
Poplar Bluff	2,400	$1,500
Rich Hill	1,200	720
Richmond	1,650	1,150
St. Charles	1,500	....
Slater	1,200	....
St. Joseph	3,000	....
St. Louis	8,000	[1] 4,500
Sedalia	2,400	....
Sikeston	1,600	....
Springfield	3,200	950
Trenton	1,900	1,200
Warrensburg	1,600	....
Washington	1,400	1,000
Webb City	2,400	....
Webster Groves	2,750	....
Wellston	2,500	....
West Plains	1,575	....
Average for 61 cities	1,996	....

[1] Three additional at $4,500.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

MONTANA.

County.	Superintendent.	City.	Superintendent.	Assistant.
Beaverhead	$1,500	Anaconda	$3,200	....
Big Horn	1,200	Billings	3,200	....
Blaine	1,200	Bozeman	3,000	....
Broadwater	1,200	Butte	4,500	$2,100
Carbon	1,500	Deer Lodge	2,000	....
Cascade	1,500	Great Falls	4,000	....
Chouteau	1,500	Havre	2,500	....
Custer	1,500	Helena	4,000	....
Dawson	1,500	Kalispell	2,500	....
Deer Lodge	1,500	Lewistown	3,000	....
Fallon	1,500	Livingston	2,600	....
Fergus	1,500	Miles City	2,800	....
Flathead	1,500	Missoula	3,000	....
Gallatin	1,500	Red Lodge	2,200	....
Granite	1,200			
Hill	1,200	Average for 14 cities	3,036	....
Jefferson	1,200			
Lewis and Clark	1,500			
Lincoln	1,200			
Madison	1,200			
Meagher	1,500			
Mineral	1,200			
Missoula	1,500			
Musselshel	1,500			
Park	1,500			
Phillips	1,200			
Powell	1,200			
Prairie	1,200			
Ravalli	1,200			
Richland	1,200			
Rosebud	1,500			
Sanders	1,200			
Sheridan	1,200			
Silver Bow	2,000			
Stillwater	1,200			
Sweet Grass	1,200			
Teton	1,500			
Toole	1,200			
Valley	1,200			
Wilbaux	1,200			
Yellowstone	1,500			
Average for 41 counties	1,355			

NEBRASKA.

Adams	$1,600	Alliance	$2,600	....
Antelope	1,500	Auburn	1,950	....
Arthur	660	Aurora	2,250	....
Banner	450	Beatrice	2,400	....
Blaine	680	Benson	1,800	....
Boone	1,400	Blair	2,000	$1,250
Box Butte	1,100	Chadron	1,600	....
Boyd	1,300	Columbus	1,900	....
Brown	1,100	Fairbury	1,800	....
Buffalo	1,800	Falls City	1,440	....
Burt	1,400	Fremont	3,000	....
Butler	1,500	Grand Island	2,200	1,100
Cass	1,600	Hastings	2,700	....
Cedar	1,400	Havelock	1,530	....
Chase	1,000	Holdrege	1,700	1,000
Cherry	1,400	Kearney	2,400	1,200
Cheyenne	1,200	Lincoln	4,000	....
Clay	1,600	McCook	1,900	....
Colfax	1,400	Nebraska City	2,100	....
Cuming	1,400	Norfolk	1,800	....
Custer	2,000	North Platte	2,000	....
Dakota	1,100	Omaha	5,400	2,400
Dawes	1,300	Plattsmouth	1,800	....
Dawson	1,500	University Place	1,700	....
Deuel	800	Wymore	1,500	....
Dixon	1,400	York	2,400	....
Dodge	1,800			
Douglas	2,200	Average for 26 cities	2,226	....
Dundy	1,000			
Fillmore	1,400			
Franklin	1,300			
Frontier	1,300			
Furnas	1,400			

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NEBRASKA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Gage	$1,800			
Garden	1,000			
Garfield	800			
Gosper	1,000			
Grant	750			
Greeley	1,300			
Hall	1,600			
Hamilton	1,440			
Harlan	1,300			
Hayes	1,000			
Hitchcock	1,100			
Holt	1,400			
Hooker	800			
Howard	1,400			
Jefferson	1,400			
Johnson	1,300			
Kearney	1,300			
Keith	1,000			
Keya Paha	1,000			
Kimball	1,000			
Knox	1,800			
Lancaster	2,200			
Lincoln	1,600			
Logan	423			
Loup	445			
McPherson	405			
Madison	1,800			
Merrick	1,300			
Morrill	1,100			
Nance	1,300			
Nemaha	1,400			
Nuckolls	1,400			
Otoe	1,600			
Pawnee	1,300			
Perkins	1,000			
Phelps	1,300			
Pierce	1,300			
Platte	1,675			
Polk	1,300			
Red Willow	1,300			
Richardson	1,600			
Rock	1,000			
Saline	1,400			
Sarpy	1,300			
Saunders	1,800			
Scotts Bluff	1,400			
Seward	1,400			
Sheridan	1,300			
Sherman	1,300			
Sioux	1,000			
Stanton	1,300			
Thayer	1,400			
Thomas	600			
Thurston	1,300			
Valley	1,300			
Washington	1,600			
Wayne	1,300			
Webster	1,400			
Wheeler	600			
York	1,500			
Average for 93 counties	1,284			

NEVADA.

Supervisory district.	Superintendent.	City.	Superintendent.	Assistant.
FIRST DISTRICT.		Carson City	$2,100	$1,250
Elko	$2,000	Elko	2,100	....
		Ely	2,400	....
SECOND DISTRICT.		Goldfield	3,000	....
		McGill	2,000	....
Eureka	2,000	Reno	3,300	2,400
Lander		Sparks	2,000	1,100
White Pine		Tonopah	3,000	....
		Average for 8 cities	2,488	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NEVADA—Continued.

Supervisory district.	Superintendent.	City.	Superintendent.	Assistant.
THIRD DISTRICT.				
Churchill	$2,000			
Humbolt				
FOURTH DISTRICT.				
Douglas	2,000			
Lyon				
Mineral				
Ormsby				
Story				
Washoe				
FIFTH DISTRICT.				
Clark	2,000			
Esmeralda				
Lincoln				
Nye				
Average for five districts	2,000			

NEW MEXICO.

County.	Superintendent.	City.	Superintendent.	Assistant.
Bernalillo	$2,000	Albuquerque	$2,500	....
Chaves	2,000	Clovis	1,800	....
Colfax	2,000	Deming	2,400	....
Curry	1,500	Las Cruces	1,860	....
Dona Ana	2,000	Las Vegas	1,100	....
Eddy	1,800	Raton	2,000	....
Grant	1,800	Roswell	2,400	$1,560
Gaudalupe	1,800	Silver City	1,800	....
Lincoln	1,500	Tucumcari	1,600	....
Luna	1,800	Santa Fe	2,000	....
Mora	1,500			
McKinley	1,500	Average for 10 cities	1,946	....
Otero	1,800			
Quay	1,800			
Rio Arriba	1,400			
Roosevelt	1,500			
Sandoval	1,300			
San Juan	1,400			
San Miguel	2,000			
Santa Fe	1,800			
Sierra	1,400			
Socorro	1,800			
Taos	1,200			
Torrance	1,500			
Union	1,800			
Valencia	1,800			
Average for 25 counties	1,663			

NEW HAMPSHIRE.

Union district.[1]	Superintendent.
Claremont, Charlestown	$2,050
Colebrook, Errol, Stewartstown, Wentworth Location	2,200
Conway, Madison, Bartlett	1,700
Derry, Londonderry	1,750
Exeter, Newfields, Kensington, Hampton Falls	2,600
Franklin, Hill	1,800
Goffstown, Bedford, New Boston	1,800
Gorham, Randolph, Shelburne	2,000
Greenland, Newington, Durham, Rye	1,900

City.	Superintendent.
Berlin	$2,500
Concord	2,800
Dover	2,000
Laconia	2,100
Manchester	4,000
Nashua	2,700
Portsmouth	2,200
Rochester	1,850
Average for 8 cities	2,519

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[1] Names of towns in supervisory unions.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NEW HAMPSHIRE—Continued.

Union district.	Superintendent.	City	Superintendent.
Hampstead, Raymond, Lee, Epping, Hampton	$2,000		
Hillsboro, Antrim, Peterboro	1,800		
Hinsdale, Swanzey, Dublin, Winchester	1,650		
Hopkinton, Weare, Dunbarton, Henniker	1,800		
Lebanon, Enfield	2,000		
Lisbon, Landaff, Franconia	2,100		
Littleton, Bethlehem Town	1,900		
Milford, Amherst, Hollis	1,800		
Newport, New London	1,800		
Northwood, Deerfield, Lee	1,500		
Pembroke, Allenstown, Merrimack	1,800		
Penacook and Concord Town District	1,800		
Pittsfield, Chichester, Loudon	1,500		
Salem, Atkinson, Hudson	1,680		
Somersworth, Newmarket	2,000		
Stratford, Northumberland, Columbia	2,200		
Tilton, Belmont, Gilmanton	1,850		
Troy, Fitzwilliam, Rindge, Jaffrey	1,650		
Walpole, Westmoreland, Langdon, and Marlboro	1,900		
Whitefield, Jefferson, Bethlehem Special	2,550		
Wilton, Hancock, Temple, New Ipswich	1,800		
Wolfeboro, Alton, Farmington	2,400		
Woodsville, Haverhill, Bath, Monroe	2,100		
Average for 32 union districts	1,918		

NEW JERSEY.

County.	Superintendent.	City.	Superintendent.	Assistant.
Atlantic	$3,000	Asbury Park	$3,000	....
Bergen	3,000	Atlantic City	4,250	....
Burlington	3,000	Bayonne	4,500	....
Camden	3,000	Belleville	3,500	....
Cape May	3,000	Bernardsville	3,600	....
Cumberland	3,000	Bloomfield	4,000	....
Essex	3,000	Boonton	2,000	....
Gloucester	3,000	Bordentown	1,550	....
Hudson	3,000	Boundbrook	1,800	$1,450
Hunterdon	3,000	Bridgeton	2,200	....
Mercer	3,000	Burlington	1,700	1,400
Middlesex	3,000	Camden	3,750	2,000
Monmouth	3,000	Cape May City	1,650	....
Morris	3,000	Carlstadt	1,900	....
Ocean	3,000	Collingswood	2,100	....
Passaic	3,000	Dover	2,500	....
Salem	3,000	East Newark	1,800	1,000
Somerset	3,000	East Orange	4,750	....
Sussex	3,000	East Rutherford	2,000	....
Union	3,000	Edgewater	1,650	....
Warren	3,000	Elizabeth	4,250	....
		Englewood	4,000	....
Average for 21 counties	3,000	Flemington	2,200	....
		Fort Lee	1,900	....
		Freehold	2,500	....
		Garfield	2,500	....
		Glen Ridge	3,500	....
		Gloucester	2,200	....
		Guttenberg	2,500	....
		Hackensack	3,750	....
		Hackettstown	1,500	....
		Haddonfield	2,200	....
		Haledon	2.000	....
		Hammonton	2,300	....
		Harrison	2,500	....
		Hawthorne	1,700	1,300
		Hoboken	4,000	3.600
		Irvington	3.000	2,400
		Jersey City	7,000	4,000
		Kearny	3,600	1,700
		Keyport	1,500	875
		Lambertville	1,700	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NEW JERSEY—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
		Little Ferry	$2,160	....
		Lodi	2,000	....
		Long Branch	4,000	....
		Madison	2,500	....
		Millville	2,100	....
		Montclair	6,000	$3,500
		Morristown	3,500	....
		Newark	7,000	4 at 4,500
		New Brunswick	3,500	....
		Newton	2,500	....
		North Bergen	2,800	
		North Plainfield	2,500	....
		Nutley	3,500	....
		Ocean City	2,200	....
		Orange	3,600	....
		Passaic	3,600	1,800
		Patterson	4,250	....
		Perth Amboy	3,500	....
		Phillipsburg	2,500	....
		Plainfield	4,500	....
		Pleasantville	2,000	....
		Princeton	2,000	....
		Prospect Park	1,800	....
		Rahway	2,700	....
		Raritan	1,400	....
		Red Bank	2,750	....
		Ridgewood	3,500	....
		Roosevelt	2,500	....
		Roselle	2,200	....
		Rutherford	2,700	....
		Salem	2,200	....
		Secaucus	1,600	....
		Somerville	2,400	....
		South Amboy	2,000	....
		South Orange	3,700	....
		South River	1,800	....
		Summit	3,600	....
		Tenafly	2,200	....
		Trenton	4,000	....
		Town of Union	3,200	....
		Vineland	2,000	....
		Wallington	1,700	....
		Washington	1,600	....
		Weehawken	2,500	....
		Westfield	3,800	....
		West Hoboken	3,800	....
		West New York	3,000	....
		West Orange	3,400	....
		Wharton	1,450	....
		Woodbury	2,350	....
		Average for 92 cities	2,832	....

NEW YORK.

County and supervisory district.	Superintendent.	City.	Superintendent.	Assistant.
Albany:		Albany	$3,500	....
District No. 1	$1,200	Albion	2,000	....
No. 2	1,200	Amityville	2,050	....
No. 3	1,500	Amsterdam	3,300	....
Allegany:		Auburn	3,500	....
District No. 1	1,400	Babylon	1,900	....
No. 2	1,400	Baldwinsville	1,800	....
No. 3	1,400	Ballston Spa	1,800	....
No. 4	1,400	Batavia	2,300	....
No. 5	1,400	Bath	1,650	....
Broome:		Binghamton	4,500	....
District No. 1	1,200	Buffalo	6,000	....
No. 2	1,200	Canandaigua	2,600	....
No. 3	1,200	Canastota	1,700	....
No. 4	1,200	Canton	1,700	$850

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NEW YORK—Continued.

County and supervisory district.	Superintendent.	City.	Superintendent.	Assistant.
Cattaraugus:		Carthage	$2,400	....
District No. 1	$1,500	Catskill	2,200	....
No. 2	1,500	Cohoes	2,000	....
No. 3	1,500	Cold Springs	1,250	....
No. 4	1,500	Cortland	2,500	....
No. 5	1,500	Clyde	1,400	....
Cayuga:		Corning:		
District No. 1	1,200	District No. 9	3,000	....
No. 2	1,200	District No. 13	2,300	....
No. 3	1,200	Dansville	2,000	....
No. 4	1,200	Depew	2,000	$900
No. 5	1,200	Dobbs Ferry	2,250	....
Chautauqua:		Dodgeville	1,400	....
District No. 1	1,200	Dunkirk	2,400	....
No. 2	1,200	East Aurora	2,250	....
No. 3	1,200	East Syracuse	2,000	1,600
No. 4	1,200	Ellenville	1,700	1,200
No. 5	1,200	Elmira	4,000	....
No. 6	1,200	Elmira Heights	1,650	....
Chemung:		Fairport	1,800	....
District No. 1	1,500	Fort Edward	1,600	....
No. 2	1,500	Fort Plain	1,600	....
Chenango:		Frankfort	1,750	....
District No. 1	1,200	Fredonia	1,500	....
No. 2	1,200	Freeport	3,000	....
No. 3	1,200	Fulton	2,600	....
No. 4	1,200	Geneva	3,000	....
No. 5	1,200	Glen Falls	2,900	....
Clinton:		Gloversville	3,000	....
District No. 1	1,200	Goshen	1,900	....
No. 2	1,200	Gouverneur	1,900	1,300
No. 3	1,200	Granville	1,700	700
Columbia:		Green Island	1,800	....
District No. 1	1,200	Greenport	2,400	....
No. 2	1,200	Hastings-upon-Hudson	2,400	....
No. 3	1,200	Haverstraw	2,500	....
Cortland:		Hempstead	3,000	....
District No. 1	1,200	Herkimer	2,400	....
No. 2	1,200	Homer	1,700	....
No. 3	1,200	Hoosick Falls	2,000	....
Delaware:		Hornell	2,500	....
District No. 1	1,200	Hudson	2,500	....
No. 2	1,200	Hudson Falls	1,800	....
No. 3	1,200	Ilion	2,400	....
No. 4	1,200	Ithaca	3,600	....
No. 5	1,200	Jamestown	3,150	....
No. 6	1,200	Johnston City	2,300	....
Dutchess:		Johnstown	2,500	....
District No. 1	1,200	Kingston	3,000	....
No. 2	1,200	Lackawanna	2,300	....
No. 3	1,200	Lancaster	1,900	....
No. 4	1,200	Lansingburgh	2,500	....
Erie:		Le Roy	1,950	....
District No. 1	2,000	Little Falls	3,000	....
No. 2	2,000	Lockport	2,500	....
No. 3	2,000	Lowville	2,100	....
No. 4	2,000	Lyons	2,000	....
No. 5	2,000			
Essex:				
District No. 1	1,500			
No. 2	1,200			
No. 3	1,500			
Franklin:				
District No. 1	1,325			
No. 2	1,700			
No. 3	1,500			
No. 4	1,500			
Fulton:				
District No. 1	1,600			
No. 2	1,500			
Genesee:				
District No. 1	1,200			
No. 2	1,200			
Greene:				
District No. 1	1,200			
No. 2	1,200			
No. 3	1,300			

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NEW YORK—Continued.

County and supervisory district.	Superintendent.
Hamilton	$1,700
Herkimer:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,200
Jefferson:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,200
No. 5	1,200
No. 6	1,200
Lewis:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,200
Livingston:	
District No. 1	1,400
No. 2	1,400
No. 3	1.500
Madison:	
District No. 1	1,350
No. 2	1,350
No. 3	1,350
No. 4	1,350
Monroe:	
District No. 1	1,700
No. 2	1,700
No. 3	1,700
No. 4	1,700
Montgomery:	
District No. 1	1,200
No. 2	1,200
Nassau:	
District No. 1	3,000
No. 2	3,000
Niagara:	
No. 1	1,400
No. 2	1,400
No. 3	1,500
Oneida:	
District No. 1	2,500
No. 2	1,800
No. 3	1,800
No. 4	1,800
No. 5	1,200
No. 6	1,800
No. 7	1,400
Onondaga:	
District No. 1	1,400
No. 2	1,700
No. 3	1,400
No. 4	1,800
No. 5	1,700
Ontario:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,200
Orange:	
District No. 1	1,400
No. 2	1,200
No. 3	1,400
Orleans:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
Oswego:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,400
No. 5	1,200

City.	Superintendent.	Assistant.
Malone	$2,700	....
Mamaroneck	2,700	....
Massena	2,000	....
Mechanicsville	2,400	....
Medina	2,000	$900
Middletown	2,600	....
Mount Kisco	1,900	....
Mount Morris	1,500	....
Mount Vernon	4,500	1,400
Newark	2,000	....
Newburgh	2,500	....
New Rochelle	5,000	1,350
New York	10,000	[1] 6,500
Niagara Falls	3,100	....
North Tarrytown	2,500	....
North Tonawanda	3,000	....
Norwich	2,150	....
Nyack	3,500	....
Ogdensburg	2,300	....
Olean	2,900	800
Oneida	2,000	....
Oneonta	2,500	....
Ossining	2,500	....
Oswego	1,800	....
Owego	1,400	....
Patchogue	2,400	....
Peekskill:		
District No. 7	2,400	....
District No. 8	2,500	....
Penn Yan	1,800	....
Perry	2,200	....
Plattsburg	2,200	....
Port Chester	3,500	1,200
Port Jervis	2,100	....
Potsdam	1,200	....
Poughkeepsie	3,250	....
Rensselaer	1,800	....
Rochester	6,500	[2] 4,000
Rockville Center	2,600	....
Rome	3,000	....
Rye	2,600	....
Sag Harbor	1,500	....
St. Johnsville	1,500	....
Salamanca	2,000	....
Saranac Lake	2,500	....
Saratoga Springs	2,500	....
Saugerties	1,900	....
Schenectady	3,500	....
Scotia	1,800	....
Seneca Falls	1,800	....
Sidney	1,625	700
Silver Creek	1,800	....
Solvay	2,800	....
Southampton	2,000	....
Suffern	2,000	....
Syracuse	4,000	2,000
Tarrytown	3,200	1,800
Tonawanda	2,800	....
Troy	3,000	....
Lansingburg district	2,500	....
Tupper Lake	1,500	....
Utica	4,000	....
Walden	1,900	....
Walton	1,600	....
Wappingers Falls	1,500	....
Warsaw	1,900	....
Waterford	1,850	....
Waterloo	1,650	1,000
Watertown	2,700	....
Watervleit	2,000	....
Watkins	1,550	....
Waverly	1,800	....
Wellsville	2,500	....
Westfield	1,700	....
Whitehall	1,700	900

[1] Seven additional at $6,500, each.

One additional at $4,000.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NEW YORK—Continued.

County and supervisory districts.	Superintendent.
Otsego:	
District No. 1	$1.200
No. 2	1,200
No. 3	1,200
No. 4	1,200
No. 5	1,200
No. 6	1,200
Putnam	1,400
Rensselaer:	
District No. 1	1,500
No. 2	1,200
No. 3	1,200
Rockland	1,200
St. Lawrence:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,200
No. 5	1,200
No. 6	1,200
No. 7	1,700
No. 8	1,200
Saratoga:	
District No. 1	1,500
No. 2	1,200
No. 3	1,500
No. 4	1,200
Schenectady	1,600
Schoharie:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
Schuyler:	
District No. 1	1,200
No. 2	1,200
Seneca:	
District No. 1	1,200
No. 2	1,200
Steuben:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,200
No. 5	1,200
No. 6	1,200
No. 7	1,400
Suffolk:	
District No. 1	1,700
No. 2	1,700
No. 3	1,700
Sullivan:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
Tioga:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
Tompkins:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
Ulster:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,200
Warren:	
District No. 1	1,400
No. 2	1,400
No. 3	1,400
Washington:	
District No. 1	1,200
No. 2	1,200
No. 3	1,200
No. 4	1,200

City.	Superintendent.	Assistant.
White Plains	$4,000	....
Yonkers	5,500	[1] $3,500
Average for 147 cities	2,465	

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[1] One additional at $2,300.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NEW YORK—Continued.

County and supervisory districts.	Superintendent.	City.	Superintendent.	Assistant.
Wayne:				
District No. 1	$1,200			
No. 2	1,200			
No. 3	1,200			
No. 4	1,200			
Westchester:				
District No. 1	1,800			
No. 2	2,400			
No. 3	2,400			
No. 4	1,800			
Wyoming:				
District No. 1	1,200			
No. 2	1,200			
No. 3	1,200			
Yates:				
District No. 1	1,200			
No. 2	1,200			
Average for 207 districts	1,352			

NORTH CAROLINA.

County.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Alamance	$1,500	$900	Asheville	$2,400	....
Alexander	864	....	Belhaven	1,000	....
Alleghany	750	....	Burlington	1,650	....
Anson	1,200	....	Charlotte	2,650	$1,800
Ashe	900	....	Concord	1,500	....
Avery	1,146	....	Fayetteville	1,800	....
Beaufort	1,800	....	Elizabeth City	1,800	....
Bertie	1,475	....	Gastonia	2,000	....
Bladen	900	....	Goldsboro	1,800	1,500
Brunswick	900	....	Graham	1,400	....
Buncombe	1,800	....	Greensboro	2,400	....
Burke	807	....	Greenville	1,800	....
Cabarrus	1,200	....	Hickory	1,800	....
Caldwell	1,100	....	High Point	1,700	1,200
Camden	600	....	Kinston	1,800	....
Carteret	500	....	Lenoir	1,200	....
Caswell	850	....	Lexington	1,500	....
Catawba	1,200	800	Monroe	1,800	....
Chatham	1,200	....	Morganton	1,350	....
Cherokee	700	....	Mount Airy	1,500	....
Chowan	860	....	Newbern	2,200	....
Clay	300	....	Oxford	1,500	....
Cleveland	1,500	....	Raleigh	2,500	....
Columbus	1,500	750	Reidsville	1,500	1,200
Craven	1,800	....	Rocky Mount	1,800	....
Cumberland	1,500	....	Salisbury	1,800	1,200
Currituck	1,200	....	Tarboro	2,000	....
Dare	423	....	Thomasville	1,350	....
Davidson	1,200	....	Washington	1,800	....
Davie	862	....	Wilson	1,500	....
Duplin	1,200	....	Winston-Salem	2,500	....
Durham	2,500	....			
Edgecombe	1,500	750	Average for 31 cities	1,785	....
Forsyth	1,692	....			
Franklin	1,267	....			
Gaston	1,800	900			
Gates	600	....			
Graham	315	....			
Granville	1,800	900			
Greene	998	....			
Guilford	2,387	....			
Halifax	1,500	750			
Harnett	1,500	750			
Haywood	900	....			
Henderson	1,000	....			
Hertford	827	....			
Hoke	1,010	....			
Hyde	585	....			
Iredell	1,375	....			
Jackson	912	....			
Johnston	1,750	1,200			

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NORTH CAROLINA—Continued.

County.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Jones	$600				
Lee	1,000				
Lenoir	1,500	$900			
Lincoln	780				
Macon	956				
Madison	1,440				
Martin	1,200				
McDowell	1,200	950			
Mecklenberg	2,000				
Mitchell	568				
Montgomery	600				
Moore	1,200				
Nash	1,192				
New Hanover	1,200				
Northampton	1,500	800			
Onslow	900				
Orange	900	1,000			
Pamlico	1,000				
Pasquotank	1,000				
Pender	1,175				
Perquimans	562				
Person	800				
Pitt	1,825				
Polk	536				
Randolph	1,000				
Richmond	1,250	750			
Robeson	1,800				
Rockingham	1,800				
Rowan	1,620				
Rutherford	1,200				
Sampson	1,200				
Scotland	1,800				
Stanly	900				
Stokes	960				
Surry	1,200				
Swain	750				
Transylvania	900				
Tyrrell	300				
Union	1,220				
Vance	1,500				
Wake	2,400	[1] 900			
Warren	1,200				
Washington	876				
Watauga	510				
Wayne	1,500				
Wilkes	1,800				
Wilson	1,500				
Yadkin	900	900			
Yancey	850				
Average for 100 counties	1,140				

NORTH DAKOTA.

County.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Adams	$1,400		Bismarck	$2,400	$1,650
Barnes	2,000	$1,200	Devils Lake	2,300	
Benson	1,700		Dickinson	2,500	1,215
Billings	1,600		Fargo	3,600	
Bottineau	1,800	80	Grafton	2,200	
Bowman	1,500		Grand Forks	4,000	
Burke	1,600		Jamestown	2,500	1,300
Burleigh	1,700		Kenmare	1,976	
Cass	2,000	1,200	Mandan	2,300	1,200
Cavalier	1,700	900	Minot	2,500	
Dickey	1,700		Valley City	2,500	
Divide	1,600		Wahpeton	2,000	1,200
Dunn	1,400		Williston	2,200	
Eddy	1,600				
Emmons	1,600		Average for 13 cities	2,537	
Foster	1,600				
Golden Valley	1,400				
Grand Forks	2,000	1,200			
Griggs	1,700				
Hettinger	1,400				

[1] Two additional at $900 each.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

NORTH DAKOTA—Continued.

County.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Kidder	$1,600	....			
Lamoure	1,700	....			
Logan	1,600	....			
McHenry	1,800	$1,100			
McIntosh	1,600	....			
McKenzie	1,400	....			
McLean	1,700	....			
Mercer	1,400	....			
Morton	2,000	1,457			
Mountrail	1,600	....			
Nelson	1,700	....			
Oliver	1,200	....			
Pembina	1,750	....			
Pierce	1,600	....			
Ramsey	1,800	....			
Ransom	1,600	....			
Renville	1,600	....			
Richland	2,000	1,200			
Rolette	1,600	....			
Sargent	1,700	....			
Sheridan	1,600	....			
Sioux	1,200	....			
Slope	1,400	....			
Stark	1,700	....			
Steele	1,600	....			
Stutsman	2,000	1,200			
Towner	1,700	....			
Traill	1,700	....			
Walsh	1,800	819			
Ward	2,000	2,400			
Wells	1,700	....			
Williams	1,700	1,050			
Average for 52 counties	1,643	....			

OHIO.

County.	Superintendent.	Assistant.	City.	Superintendent.	Assistant.
Adams	....	$1,543	Akron	$5,000	....
Allen	....	2,500	Alliance	2,850	....
Ashland	....	2,000	Ashland	2,400	....
Ashtabula	....	3,000	Ashtabula	2,800	....
Athens	....	1,999	Athens	2,100	....
Auglaize	....	2,000	Barberton	2,300	....
Belmont	....	2,000	Barnesville	1,600	....
Brown	....	1,650	Bellaire	2,000	....
Butler	....	2,500	Bellefontaine	2,000	$1,200
Carroll	....	1,650	Bellevue	1,900	....
Champaign	....	1,995	Berea	1,300	....
Clark	....	2,000	Bowling Green	1,600	....
Clermont	....	1,700	Bridgeport	1,800	....
Clinton	....	2,100	Bryan	2,400	....
Columbiana	....	2,000	Bucyrus	2,000	....
Coshocton	....	1,500	Byesville	1,900	....
Crawford	....	1,850	Cambridge	2,100	....
Cuyahoga	....	3,050	Canton	3,500	....
Darke	....	2,000	Celina	1,800	....
Defiance	....	2,000	Chicago Junction	1,600	....
Delaware	....	1,850	Chillicothe	2,500	....
Erie	....	2,716	Cincinnati	[1] 10,000	....
Fairfield	....	2,400	Circleville	2,300	....
Fayette	....	1,410	Cleveland	[2] 6,000	....
Franklin	....	2,000	Cleveland Heights	3,250	....
Fulton	....	2,359	Clyde	1,650	....
Gallia	....	1,741	Columbus	[3] 6,500	....
Geauga	....	1,500	Conneaut	2,250	....
Greene	....	2,000	Coshocton	2,400	....
Guernsey	....	2,000	Crestline	1,800	....
Hamilton	....	3,000	Crooksville	1,550	....
Hancock	....	1,800	Cuyahoga Falls	1,800	....
Hardin	....	1,800	Dayton	6,000	....
Harden	....	1,500	Defiance	2,000	....
Henry	....	1,800	Delaware	2,295	....

[1] One assistant superintendent at $4,500 and one at $3,000.
[2] One assistant superintendent at $3,750 and one at $3,500.
[3] One assistant superintendent at $3,000 and one at $2,500.

Table 6.—*Salaries of county and city superintendents of schools*—Continued.

OHIO—Continued.

County.	Superintendent.
Highland	$2,000
Hocking	2,000
Holmes	1,766
Huron	2,237
Jackson	1,400
Jefferson	2,500
Knox	1,800
Lake	2,499
Lawrence	1,600
Licking	2,500
Logan	2,038
Lorain	2,000
Lucas	2,400
Madison	2,000
Mahoning	1,800
Marion	2,000
Medina	2,458
Meigs	1,600
Mercer	2,000
Miami	2,000
Monroe	1,700
Montgomery	3,250
Morgan	1,066
Morrow	1,800
Muskingum	2,000
Noble	1,950
Ottawa	1,800
Paulding	1,900
Perry	2,100
Pickaway	1,700
Pike	1,500
Portage	2,000
Preble	1,900
Putnam	2,708
Richland	1,993
Ross	1,950
Sandusky	2,000
Scioto	3,000
Seneca	2,008
Shelby	1,560
Stark	3,500
Summit	2,299
Trumbull	2,500
Tuscarawas	2,008
Union	1,600
Van Wert	1,950
Vinton	1,500
Warren	1,800
Washington	1,800
Wayne	2,816
Williams	2,307
Wood	2,100
Wyandot	2,000
Average for 88 counties	**2,041**

City.	Superintendent.	Assistant.
Delphos	$1,900	....
Dover	2,500	....
Dennison	[1] 1,800	....
East Cleveland	[2] 4,000	....
East Liverpool	2,950	....
East Youngstown	1,750	....
Eaton	1,800	....
Elmwood Place	1,600	....
Elyria	2,500	....
Findlay	2,500	....
Fostoria	2,500	....
Franklin	[3] 1,650	....
Fremont	2,000	....
Galion	2,000	....
Gallipolis	2,000	....
Geneva	1,600	....
Girard	2,000	....
Glouster	1,100	....
Greenfield	[4] 2,000	....
Greenville	2,500	....
Hamilton	3,400	....
Hillsboro	1,350	....
Ironton	2,000	....
Jackson	[3] 1,800	....
Kent	1,900	....
Kenton	2,000	....
Lakewood	3,900	....
Lancaster	2,500	....
Lebanon	1,620	....
Leetonia	1,400	....
Lima	3,000	....
Lisbon	1,400	....
Lockland	2,400	....
Logan	1,800	....
London	2,000	....
Lorain	3,000	....
Mansfield	2,500	....
Marietta	2,300	....
Marion	2,400	....
Martins Ferry	2,400	....
Marysville	1,700	....
Massillon	2,500	....
Medina	2,400	....
Miamisburg	2,100	....
Middletown	2,900	....
Middleport	1,300	....
Mingo Junction	1,800	....
Montpelier	1,600	....
Mount Vernon	1,800	....
Napoleon	1,600	....
Nelsonville	1,800	....
Newark	3,000	....
New Comerstown	1,350	....
New Lexington	1,800	....
New Philadelphia	2,100	....
Niles	2,800	....
North Baltimore	1,400	....
Norwalk	2,100	....
Norwood	3,200	....
Oberlin	2,000	....
Orrville	1,700	....
Painesville	2,300	....
Piqua	2,600	....
Pomeroy	1,200	....
Port Clinton	1,700	....
Portsmouth	3,100	....
Ravenna	2,000	....
St. Bernard	2,400	....
St. Marys	1,900	....
Salem	2,400	....
Sandusky	2,900	....
Shelby	1,900	....
Sidney	2,400	....
Springfield	3,000	....
Steubenville	2,500	....
Struthers	1,900	....
Tiffin	2,250	....

[1] One assistant superintendent at $1,100.

[2] One assistant superintendent at $2,000.

[3] One assistant superintendent at $1,000.

[4] One assistant superintendent at $1,600.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

OHIO—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
		Toledo	[1] $5,000	
		Toronto	1,600	
		Troy	2,250	
		Upper Sandusky	1,680	
		Urichsville	1,500	
		Urbana	2,000	
		Van Wert	2,000	
		Wadsworth	1,900	
		Wapakoneta	2,250	
		Warren	3,000	
		Washington C. H	2,500	
		Wauseon	1,500	
		Wellston	1,600	
		Wellsville	2,000	
		West Park	2,000	
		Wilmington	1,700	
		Woodsfield	1,350	
		Wooster	2,500	
		Xenia	1,800	
		Youngstown	4,750	
		Zanesville	2,500	
		Average for 133 cities	2,344	
OKLAHOMA.				
Adair	$1,200	Ada	$1,650	
Alfalfa	1,400	Altus	1,800	
Atoka	1,200	Alva	1,500	
Beaver	1,200	Anadarko	1,400	
Beckham	1,600	Ardmore	2,640	
Blaine	1,200	Bartlesville	2,400	
Bryan	1,400	Blackwell	1,800	$1,000
Caddo	1,600	Chickasha	2,100	
Canadian	1,400	Claremore	1,500	
Carter	1,400	Clinton	1,500	
Cherokee	1,200	Durant	1,800	1,000
Choctaw	1,400	Elk City	1,700	
Cimarron	1,200	El Reno	2,250	
Cleveland	1,400	Enid	2,100	1,400
Coal	1,200	Frederick	1,500	
Comanche	1,400	Guthrie	2,000	
Cotton	1,400	Hartshorne	1,500	
Craig	1,200	Hobart	1,800	
Creek	1,400	Hugo	2,200	
Custer	1,400	Kingfisher	1,350	
Delaware	1,200	Krebs	1,500	930
Dewey	1,200	Lawton	1,800	
Ellis	1,200	Mangum	1,800	
Garfield	1,600	McAlester	2,400	
Garvin	1,400	Miami	1,700	
Grady	1,600	Muskogee	3,800	
Grant	1.400	Norman	1,500	
Greer	1,200	Oklahoma	3,600	
Harmon	1,200	Okmulgee	2,500	
Harper	1,200	Pauls Valley	1,500	
Haskell	1.400	Pawhuska	1,800	
Hughes	1,400	Perry	1,350	
Jackson	1,400	Ponca	1,800	
Jefferson	1,200	Purcell	1,500	
Johnston	1.200	Sapulpa	2,400	
Kay	1,400	Shawnee	2,400	
Kingfisher	1,400	Stillwater	1,500	1,000
Kiowa	1,400	Sulphur	1,400	900
Latimer	1,200	Tahlequah	1,125	
Le Flore	1,400	Tulsa	3,800	
Lincoln	1,600	Vinita	2,000	
Logan	1,600	Wagoner	1,600	
Love	1,200	Waurika	1,500	
Major	1,200	Woodward	1,800	
Marshall	1,200			
Mayes	1,200	Average for 44 cities	1,922	
Murray	1,200			
Muskogee	1,800			
McClain	1,200			
McCurtain	1,400			
McIntosh	1,400			

[1] One assistant superintendent at $2,500.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

OKLAHOMA—Continued.

County.	Superin-endent.	City.	Superin-tendent.	Assist-ant.
Noble	$1,200			
Nowata	1,200			
Okfuskee	1.400			
Oklahoma	1,800			
Okmulgee	1.400			
Osage	1,200			
Ottawa	1,200			
Pawnee	1,200			
Payne	1,400			
Pittsburg	1,800			
Pontotoc	1,400			
Pottawatomie	1,800			
Pushmataha	1,200			
Roger Mills	1,200			
Rogers	1,200			
Seminole	1,400			
Sequoyah	1,400			
Stephens	1,400			
Texas	1,200			
Tilman	1.400			
Tulsa	1,600			
Wagoner	1,400			
Washington	1,200			
Washita	1,400			
Woods	1,200			
Woodward	1,200			
Average for 77 counties	1,348			

OREGON.

County.	Superin-tendent.	City.	Superin-tendent.
Baker	$1,500	Albany	$2,200
Benton	1,300	Ashland	2,000
Clackamas	[1] 1,600	Astoria	2,100
Clatsop	1,200	Baker	2,400
Columbia	1,300	Corvallis	1,800
Coos	1,200	Dalles	2,000
Crook	1,600	Eugene	2,400
Curry	400	Grants Pass	1,800
Douglass	[2] 900	Klamath Falls	2,100
Gilliam	1,200	La Grande	2,000
Grant	1,200	McMinnville	1,900
Harney	1,000	Marshfield	2,200
Hood River	600	Medford	2,250
Jackson	[2] 1,800	Oregon City	1,900
Jefferson	900	Pendleton	1,800
Josephine	1,200	Portland	[3] 5,000
Klamath	1,200	Roseburg	1,800
Lake	1,200	Salem	2,250
Lane	[4] 1,500	The Dalles	2,000
Lincoln	1,000	Average for 19 cities	2,205
Linn	[2] 1,200		
Malheur	1,000		
Marion	[5] 1,500		
Morrow	1,200		
Multnomah	[6] 2,500		
Polk	[1] 1,200		
Sherman	1,000		
Tillamook	1,000		
Umatilla	1,800		
Union	1,650		
Wallowa	1,200		
Wasco	1,800		
Washington	1,200		
Wheeler	600		
Yamhill	1,200		
Average for 35 counties	1,253		

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[1] One assistant at $720.

[2] One assistant at $300.

[3] One assistant superintendent at $3,500 and one at $3,000.

[4] One assistant at $500.

[5] One assistant at $600.

[6] One assistant at $1,200.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

PENNSYLVANIA.

County.	Superintendent.
Adams	$2,000
Allegheny	7,000
Armstrong	2,000
Beaver	3,000
Bedford	2,000
Berks	4,000
Blair	2,000
Bradford	2,500
Bucks	3,000
Butler	2,250
Cambria	4,220
Cameron	1,800
Carbon	3,000
Center	2,000
Chester	3,000
Clarion	2,364
Clearfield	2,400
Clinton	2,000
Columbia	3,000
Crawford	2,000
Cumberland	2,000
Dauphin	2,000
Delaware	3,500
Elk	3,100
Erie	2,500
Fayette	3,500
Forest	1,500
Franklin	2,500
Fulton	1,500
Greene	2,500
Huntingdon	2,000
Indiana	2,200
Jefferson	2,300
Juniata	1,500
Lackawanna	5,000
Lancaster	3,000
Lawrence	2,000
Lebanon	2,250
Lehigh	2,200
Luzerne	5,000
Lycoming	3,000
McKean	2,500
Mercer	2,000
Mifflin	1,675
Monroe	1,900
Montgomery	5,000
Montour	1,500
Northampton	2,750
Northumberland	2,500
Perry	1,950
Pike	1,500
Potter	2,500
Schuylkill	3,500
Snyder	1,640
Somerset	2,000
Sullivan	1,600
Susquehanna	2,000
Tioga	2,500
Union	1,700
Venango	2,500
Warren	2,500
Washington	3,000
Wayne	2,300
Westmoreland	8,500
Wyoming	2,000
York	2,500
Average for 66 counties	2,645

City.	Superintendent.	Assistant.
Allentown	$3,500	$1,800
Altoona	3,400	....
Ambler	1,525	1,025
Apollo	1,800	1,080
Archbald	1,800	....
Ashland	1,700	....
Aspinwall	2,000	....
Athens	1,500	....
Austin	990	....
Avalon	2,300	1,600
Bangor	1,700	....
Barnesboro	1,300	810
Beaver	2,400	....
Beaver Falls	3,600	....
Bellefonte	2,000	....
Bellevue	2,400	1,250
Berwick	1,800	....
Bethlehem	2,600	....
Birdsboro	1,350	720
Blairsville	1,800	1,500
Bloomsburg	2,000	....
Brackenridge	1,500	990
Braddock	2,400	....
Bradford	2,400	....
Bridgeport	1,500	....
Bristol	1,200	....
Brookville	1,750	....
Butler	3,500	....
Canonsburg	1,800	....
Carbondale	1,800	....
Carlisle	1,800	....
Carnegie	3,300	....
Carrick	1,800	....
Catasaqua	1,600	....
Chambersburg	2,000	....
Charleroi	2,100	....
Chester	3,500	....
Clairton	2,500	....
Clarion	1,500	....
Clearfield	2,200	....
Clifton Heights	1,100	....
Coaldale	1,500	....
Coatesville	2,000	....
Columbia	1,800	....
Conemaugh	1,500	....
Connellsville	2,400	....
Conshohocken	1,800	....
Coplay	990	....
Coraopolis	1,800	....
Corry	1,750	....
Coudersport	1,450	1,000
Crafton	2,100	....
Curwensville	1,250	....
Danville	1,400	....
Darby	1,800	....
Derry	1,800	960
Dickson City	1,800	....
Donora	2,000	....
Dorranceton (Wilkes-Barre)	2,025	....
Downingtown	1,800	....
Doylestown	1,920	....
Dubois	2,400	1,400
Duquesne	2,500	....
Duryea	2,000	....
East Conemaugh	1,500	....
East Mauch Chunk	1,250	....
East Pittsburgh	1,800	....
East Stroudsburg	1,400	....
Easton	3,000	1,500
Edwardsville	1,800	....
Elizabethtown	1,080	....
Elwood City	1.800	....
Emaus	1.125	....
Emporium	1,800	1,020
Ephrata	1,000	630
Erie	4,000	....
Etna	1,800	....
Exeter (Pittston P. O.)	1.200	....
Farrell	2,200	....
Ford City	2,200	....
Forest City	1,440	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

PENNSYLVANIA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
		Frackville	$1,800	$900
		Freedom	1,800	
		Freeland	1,300	
		Galeton	1,500	
		Gallitzin	1,500	900
		Gettysburg	1,300	
		Girardville	1,450	
		Glassport	1.800	
		Greensburg	3.000	
		Greenville	2,400	
		Grove City	2,000	1,450
		Hanover	1,500	
		Harrisburg	3,500	
		Hazleton	3,000	
		Hollidaysburg	1,500	900
		Homestead	2,800	
		Honesdale	1.700	
		Huntingdon	1,600	1,500
		Indiana	1,600	
		Irwin	1,800	
		Jeannette	1,800	
		Jenkintown	2,100	
		Jermyn	1,350	
		Jersey Shore	1,450	
		Johnstown	3,500	[1] 1,500
		Johnsonburg	1,900	
		Juniata	1,500	
		Kane	1,800	
		Kingston	1,850	
		Kittanning	2,000	
		Lancaster	3,500	
		Lansdale	1.500	1,000
		Lansdowne	3.150	
		Lansford	2.000	
		Larksville	2.000	
		Latrobe	2.400	
		Lebanon	2.500	
		Leechburg	1.800	
		Lehighton	1 350	
		Lewisburg	1.200	900
		Lewistown	1.800	
		Lockhaven	1,800	
		Luzerne	1,500	
		Lykens	1,200	
		Mahanoy City	1,800	
		McAdoo	720	
		McDonald	2,000	1,320
		McKeesport	3,500	
		McKees Rocks	2,700	
		Mauch Chunk	1,350	
		Meadville	2,500	
		Mechanicsburg	1,200	
		Media	2,000	
		Meyersdale	1,400	
		Middletown	1,380	
		Millvale	2,000	
		Milton	1,800	
		Minersville	1,800	
		Monaca	1,800	
		Monessen	2,750	1,200
		Monongahela	2,000	1,200
		Moosic	1,200	
		Mount Carmel	2,000	
		Mount Oliver	1,800	
		Mount Pleasant	2,000	
		Mount Union	1,500	
		Munhall	2,300	
		Nanticoke	2,600	
		Nazareth	1,500	
		New Brighton	2,400	1,440
		New Castle	2,800	
		New Kensington	2,500	
		North Braddock	2,000	
		North East	1,500	675
		Norristown	2,600	
		Northampton	2,000	
		Northumberland	1,350	
		Oakmont	2,300	
		Old Forge	1,800	

[1] One additional at $1,400 and one at $1,250.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

PENNSYLVANIA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
		Olyphant	$2,000	
		Parkesburg	1,200	
		Parnassus	1,700	
		Parsons	1,800	
		Patton	1,500	
		Perkasie	1,140	
		Philadelphia	9,000	[1] $4,500
		Phillipsburg	1,500	
		Phoenixville	1,800	
		Pittsburgh	9,000	[2] 4,000
		Pittston	2,400	
		Plymouth	1,800	
		Portage	1,650	
		Port Carbon	1,000	
		Pottstown	2,000	
		Pottsville	2,400	
		Quakerstown	1,300	
		Rankin	1,800	
		Reading	4,000	
		Renovo	1,500	
		Reynoldsville	1,687	
		Ridgway	2,500	
		Rochester	2,400	
		Royersford	1,350	
		St. Marys	2,000	
		Schuylkill	1,260	
		Sayre	1,800	
		Scottdale	1,800	
		Scranton	5,000	
		Sewickley	3,000	
		Shamokin	3,000	
		Sharon	2,300	
		Sharpsburg	1,850	
		St. Clair	1,500	
		Sharpsville	1,525	
		Shippensburg	1,170	
		Slatington	1,700	
		Somerset	1,620	1,125
		South Bethlehem	2,100	
		South Brownsville	1,500	
		South Fork	1,200	
		South Williamsport	1,200	1,140
		Spring City	1,450	
		Stroudsburg	1,400	
		Summit Hill	1,400	
		Sunbury	2,400	
		Susquehanna	1,400	
		Swissvale	3,000	
		Swoyersville (Sugar Notch P. O.)	1,200	
		Tamaqua	2,000	1,450
		Tarentum	2,650	
		Taylor	1,700	
		Throop	1,560	
		Titusville	2,400	
		Tyrone	1,800	
		Union City	1,350	
		Uniontown	3,000	1,800
		Vandergrift Heights	2,600	
		Verona	1,850	
		Warren	2,500	
		Washington	3,000	
		Waynesboro	2,000	
		Weatherly	1,100	
		Wellsboro	1,800	
		West Berwick	1,200	
		West Chester	3,000	
		West Homestead (Homestead P. O.)	1,125	
		West Newton	1,500	
		West Pittston	2,000	
		Wilkinsburg	3,000	
		Williamsport	2,900	
		Wilmerding	2,200	
		Windber	1,600	
		Wyoming	1,100	
		York	2,500	
		Average for 235 cities	2,005	

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[1] Five at $4,500 each.

[2] Two at $4,000 each.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

RHODE ISLAND.

Towns of less than 2,500 population.	Superintendent.
Charlestown	[1] $100
East Greenwich	[1] 200
Exeter	[1] 50
Glocester, Smithfield	1,500
Hopkinton	[1] 400
Jamestown	[1] 50
Little Compton	[1] 250
Middletown	[1] 250
Naragansett, South Kingston	1,700
New Shoreham	1,500
North Smithfield	[1] 400
Portsmouth	[1] 100
Richmond	[1] 200
Scituate	[1] 350
Tiverton	[1] 35
West Greenwich	[1] 125
West Warwick	1,700
Average for 13 towns with part-time superintendents	193
Average for 4 full-time superintendents with 6 towns with less than 2,500 population	1,600

Cities and towns of 2,500 population and over.	Superintendent.
Barrington	$1,500
Bristol	2,000
Burrillville	1,500
Central Falls	2,000
Coventry	1,500
Cranston	2,250
Cumberland	1,750
East Providence	2,000
Johnston	1,500
Lincoln	1,700
Newport	3,000
North Kingstown	1,500
North Providence	1,700
Pawtucket	3,000
Providence	5,000
Warren	1,800
Warwick	2,000
Westerly	2,400
Woonsocket	2,500
Average for 19 cities and towns with 2,500 population or over	2,137

SOUTH CAROLINA.

County.	Superintendent.
Abbeville	$900
Aiken	1,200
Anderson	900
Barnwell	1,200
Beaufort	600
Berkeley	600
Calhoun	900
Charleston	1,500
Cherokee	900
Chester	750
Chesterfield	1,200
Clarendon	1,200
Colleton	900
Darlington	1,500
Dillon	1,100
Dorchester	800
Edgefield	780
Fairfield	550
Florence	1,800
Georgetown	1,200
Greenville	1,200
Greenwood	900
Hampton	700
Horry	800
Jasper	600
Kershaw	1,200
Lancaster	600
Laurens	750
Lee	1,200
Lexington	1,000
Marion	800
Marlboro	1,000
Newberry	900
Oconee	800
Orangeburg	1,200
Pickens	1,100
Richland	1,800
Saluda	650
Spartanburg	1,200
Sumter	1,500
Union	900
Williamsburg	1,000
York	1,100
Average for 44 counties	986

City.	Superintendent.
Aiken	$1,200
Anderson	2,100
Camden	1,215
Charleston	2,500
Cheraw	1,250
Chester	1,500
Columbia	2,500
Darlington	1,800
Easley	1,500
Florence	2,100
Gaffney	1,500
Georgetown	1,600
Greenville	2,700
Laurens	1,600
Newberry	1,800
Orangeburg	2,000
Rock Hill	2,100
Spartanburg	2,200
Union	1,700
Average for 20 cities	1,853

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[1] Member of school board paid for part time for services as superintendent.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

SOUTH DAKOTA.

County.	Superintendent.	City.	Superintendent.
Aurora	$1,227	Aberdeen	$3,610
Beadle	1,500	Brookings	1,900
Bennett	486	Deadwood	2,150
Bon Homme	1,500	Huron	2,600
Brookings	1,500	Lead	3,200
Brown	1,500	Madison	1,800
Brule	1,157	Mitchell	3,000
Buffalo	486	Redfield	2,300
Butte	961	Sioux Falls	3,500
Campbell	860	Watertown	2,400
Charles Mix	1,500	Yankton	2,000
Clark	1,500		
Clay	1,368	Average for 11 cities	2,587
Codington	1,500		
Custer	766		
Davidson	1,500		
Day	1,500		
Dewey	912		
Douglas	1,052		
Edmunds	1,150		
Fall River	1,222		
Faulk	1,101		
Grant	1,431		
Gregory	1,500		
Haakon	900		
Hamlin	1,303		
Hand	1,332		
Hanson	1,248		
Harding	954		
Hughes	1,005		
Hutchinson	1,500		
Hyde	827		
Jackson	689		
Jerauld	985		
Kingsbury	1,500		
Lake	1,500		
Lawrence	1,500		
Lincoln	1,500		
Lyman	1,381		
McCook	1,500		
McPherson	1,106		
Marshall	1,343		
Meade	1,500		
Mellette	499		
Miner	1,245		
Minnehaha	1,500		
Pennington	1,500		
Perkins	1,272		
Potter	883		
Roberts	1,500		
Sanborn	1,222		
Spink	1,500		
Stanley	759		
Sully	828		
Tripp	1,264		
Turner	1,500		
Union	1,486		
Walworth	1,117		
Yankton	1,500		
Ziebach	537		
Average for 60 counties	1,214		

TENNESSEE.

Anderson	$800	Bristol	$1,800
Bedford	600	Chattanooga	2,750
Benton	578	Clarksville	2,000
Bledsoe	650	Cleveland	1,500
Blount	1,000	Columbia	[1] 1,800
Bradley	850	Covington	2,040
Campbell	1,350	Greeneville	1,200
Cannon	700	Harriman	1,500
Carroll	1,150	Humboldt	1,700
Carter	700	Jackson	1,800
Cheatham	700	Johnson City	2,250
Chester	600	Knoxville	3,000
Claiborne	700	Lafollette	1,500
Clay	582	Lebanon	1,500
Cocke	750	Lenoir City	1,400
Coffee	700	Lonsdale	1,000

[1] One assistant at $1,200.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

TENNESSEE—Continued.

County.	Superintendent.
Crockett	$850
Cumberland	1,070
Davidson	2,750
Decatur	700
Dekalb	700
Dickson	750
Dyer	680
Fayette	1,350
Fentress	650
Franklin	950
Gibson	1,164
Giles	1,000
Grainger	750
Greene	1,350
Grundy	700
Hamblen	700
Hamilton	2,750
Hancock	500
Hardeman	500
Hardin	700
Hawkins	475
Haywood	500
Henderson	525
Henry	1,154
Hickman	500
Houston	250
Humphreys	800
Jackson	700
James	500
Jefferson	890
Johnson	700
Knox	1,800
Lake	650
Lauderdale	1,500
Lawrence	1,000
Lewis	700
Lincoln	954
Loudon	1,200
McMinn	441
McNairy	750
Macon	600
Madison	1,550
Marion	750
Marshall	950
Maury	1,350
Meigs	612
Monroe	700
Montgomery	1,550
Moore	550
Morgan	583
Obion	1,350
Overton	600
Perry	700
Pickett	500
Polk	690
Putnam	750
Rhea	925
Roane	800
Robertson	1,250
Rutherford	900
Scott	850
Sequatchie	230
Sevier	450
Shelby	2,400
Smith	854
Stewart	850
Sullivan	700
Sumner	1,550
Tipton	1,550
Trousdale	400
Unicoi	300
Union	300
Van Buren	400
Warren	750
Washington	700
Wayne	550
Weakley	852
White	700
Williamson	1,250
Wilson	700
Average for 96 counties	864

City.	Superintendent.
Martin	$1,200
Maryville	900
Memphis	[1] 5,000
Morristown	1,700
Mount Pleasant	1,800
Nashville	[2] 2,600
Newport	1,125
Park City	2,000
Pulaski	1,350
Tellico Plains	1,250
Towanda	1,300
Trenton	1,500
Union City	1,800
Average for 29 cities	1,787

[1] One assistant at $1,600.

[2] One assistant at $2,400.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

TEXAS.[1]

County.[1]	Superintendent.	City.	Superintendent.
Anderson	$1,500	Amarillo	$2,500
Andrews		Austin	3,500
Angelina	1,500	Bay City	1,500
Aransas		Beaumont	3,300
Archer		Beeville	1,800
Armstrong		Big Spring	2,000
Atascosa	1,500	Bonham	2,000
Austin	1,500	Bowie	1,500
Bailey		Brady	1,800
Bandera		Brownsville	[2] 2,000
Bastrop	1,500	Brownwood	1,800
Baylor		Childress	2,400
Bee	1,300	Coleman	1,500
Bell	1,500	Corpus Christi	2,400
Bexar	1,500	Coriscana	2,400
Blanco		Crockett	1,800
Borden		Cuero	2,000
Bosque	1,500	Dalhart	1,500
Bowie	1,500	Dallas	4,000
Brazoria	1,400	Denison	2,500
Brazos	1,500	Denton	[3] 1,800
Brewster		Dublin	1,500
Briscoe		El Paso	4,200
Brooks		Ennis	2,400
Brown	1,500	Fort Worth	[4] 3,600
Burleson	1,500	Gainesville	2,000
Burnet		Galveston	3,000
Caldwell		Greenville	2,200
Calhoun		Hillsboro	1,800
Callahan	1,300	Houston	[5] 5,000
Cameron	1,500	Jefferson	1,125
Camp	1,300	Longview	2,400
Carson		Lufkin	2,000
Cass	1,500	McKinney	1,800
Castro		Marlin	2,280
Chambers		Marshall	2,500
Cherokee	1,500	Mart	[6] 2,000
Childress	1,300	Navasota	2,250
Clay	1,400	New Braunfels	1,400
Cochran		Orange	2,200
Coke		Palestine	2,259
Coleman	1,500	Paris	3,000
Colin	1,500	Plainview	1,500
Collingsworth		Quanah	2,400
Colorado	1,500	San Antonio	[4] 5,000
Comal		San Marcos	1,800
Comanche	1,500	Seguin	1,500
Coneho		Smithville	1,500
Cooke	1,500	Snyder	1,600
Coryell	1,500	Stamford	1,650
Cottle		Sulphur Springs	2.000
Crockett		Taylor	1,800
Crosby		Teague	1,500
Culberson		Temple	2,500
Dallam		Texarkana	1,750
Dallas	1,400	Tyler	[4] 2,500
Dawson		Vernon	1,800
Deaf Smith		Waco	4,000
Delta	1,400	Waxahachie	[7] 2,250
Denton	1,500	Weatherford	1,800
De Witt	1,500	Wichita Falls	2,600
Dickens		Yoakum	1,800
Dimmitt			
Donley		Average for 62 cities	2,261
Duval	1,300		
Eastland			
Ector			
Edwards			
Ellis	1,500		
El Paso	1,500		
Erath	1,500		

[1] In counties where no salary is given, the probate judge is ex officio county superintendent of schools.

[2] One assistant at $1,500.

[3] One assistant at $990.

[4] One assistant at $2,000.

[5] One assistant at $2,400.

[6] One assistant at $1,200.

[7] One assistant at $1,600.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

TEXAS—Continued.

County.	Superintendent.	City.	Superintendent.
Falls	$1,500		
Fannin	1,500		
Fayette	1,500		
Fisher	1,300		
Floyd	....		
Foard	....		
Fort Bend	1,500		
Franklin	....		
Freetone	1.500		
Frio	1,300		
Gaines	....		
Galveston	1,500		
Garza	....		
Gillespie	....		
Glasscock	....		
Goliad	1,300		
Gonzales	1,500		
Gray	....		
Grayson	1,500		
Gregg	1,500		
Grimes	1,500		
Guadalupe	1,500		
Hale	....		
Hall	1,300		
Hamilton	1,400		
Hansford	....		
Hardeman	1,300		
Hardin	1,300		
Harris	1,500		
Harrison	1,500		
Hartley	....		
Haskell	1,400		
Hays	1,400		
Hemphill	....		
Henderson	1,500		
Hidalgo	1,500		
Hill	1,500		
Hockley	1.500		
Hood	....		
Hopkins	1,500		
Houston	1,500		
Howard	....		
Hunt	1.500		
Hutchison	....		
Irion	....		
Jack	1,300		
Jackson	1,500		
Jasper	....		
Jeff Davis	....		
Jefferson	1,500		
Jim Hogg	....		
Jim Wells	1,300		
Johnson	1,500		
Jones	1,500		
Karnes	1,500		
Kaufman	1,500		
Kendall	....		
Kent	....		
Kerr	....		
Kimble	....		
King	....		
Kinney	....		
Kleburg	....		
Knox	....		
Lamar	1,500		
Lamb	....		
Lampasas	....		
La Salle	....		
Lavaca	1,500		
Lee	1,400		
Leon	1,500		
Liberty	1,300		
Limestone	1,500		
Lipscomb	....		
Live Oak	....		
Llano	....		
Loving	....		
Lubbock	....		

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

TEXAS—Continued.

County.	Superintendent.	City.	Superintendent.
Lynn			
Madison	$1,300		
Marion	1,300		
Martin			
Mason			
Matagorda			
Maverick			
McCulloch	1,300		
McLennan	1.500		
McMullen			
Medina	1,400		
Menard			
Midland			
Milam	1,500		
Mills			
Mitchell			
Montague	1,500		
Montgomery	1,400		
Moore			
Morris			
Motley			
Nacogdoches	1,500		
Navarro	1,500		
Newton	1,100		
Nolan	1,300		
Nueces	1,500		
Ochiltree			
Oldham			
Orange			
Palo Pinto	1,500		
Panola	1,500		
Parker	1,500		
Parmer			
Pecos			
Polk	1,500		
Potter			
Presidio			
Rains			
Randall			
Reagan			
Real			
Red River	1,500		
Reeves			
Refugio			
Roberts			
Robertson	1,500		
Rockwall			
Runnels	1,500		
Rusk	1,500		
Sabine	1,300		
San Augustine	1,400		
San Jacinto			
San Patricio	1,300		
San Saba	1,300		
Schleicher			
Scurry	1,300		
Shackelford			
Shelby	1,500		
Sherman			
Smith	1,500		
Somervell			
Starr	1,300		
Stephens			
Sterling			
Stonewall	1,100		
Sutton			
Swisher			
Tarrant	1,500		
Taylor	1,500		
Terrell			
Terry			
Throckmorton			
Titus	1.400		
Tom Green	1,400		
Travis	1,500		
Trinity	1,400		
Tyler	1,300		

Table 6.—*Salaries of county and city superintendents of schools*—Continued.

TEXAS—Continued

County.	Superintendent.	City.	Superintendent.
Upshur	$1,500		
Upton	....		
Uvalde	1,300		
Valverde	....		
Van Zandt	1,500		
Victoria	1,400		
Walker	1,400		
Waller	1,300		
Ward	....		
Washington	1,500		
Webb	1,500		
Wharton	....		
Wheeler	....		
Wichita	....		
Wilbarger	1,400		
Willacy	....		
Williamson	1,500		
Wilson	1,500		
Winkler	....		
Wise	1.500		
Wood	1,500		
Yoakum	....		
Young	1 300		
Zapata	....		
Zavala	....		
Average for 129 counties	1,439		

UTAH.

County.	Superintendent.	City.	Superintendent.
Beaver	$1,500	American Fork	$2,000
Box Elder	2,700	Bingham	2,100
Cache	2,000	Brigham	2,700
Carbon	1,500	Eureka	2,760
Davis	2,000	Logan	2,100
Duchesne	1,200	Midvale	[3] 3,400
Emery	800	Murray	2,400
Garfield	1,050	Nephi	1,420
Grand	400	Ogden	3,800
Iron	1,550	Provo	1,800
Juab:		Richfield	1,800
Juab district	1,337	Salt Lake City	[2] 4,800
Tintic district	2,700	Spanish Fork	2,100
Kane	750	Springville	1,750
Millard	1,200	Tooele	2,000
Morgan	742		
Piute	800	Average for 15 cities	2,458
Rich	500		
Salt Lake:			
Grand district	2,100		
Jordan district	3,400		
San Juan	3,572		
Sanpete:			
North district	1,500		
South district	1,625		
Sevier	1,800		
Summit	1,984		
Tooele	2,000		
Uintah	1,833		
Utah:			
Alpine district	1,800		
Nebo district	1,800		
Wasatch	1,500		
Washington	200		
Wayne	249		
Weber	2,000		
Average for 32 counties	1,465		

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[1] Four counties contain 2 districts and 2 district superintendents each.
[2] One assistant at $3,600.
[3] One assistant at $1,000.

Table 6.—*Salaries of county and city superintendents of schools*—Continued.

VERMONT.

Union district.[1]	Superintendent.	City.	Superintendent.
Bristol	$1.500	Barre	$2.100
Proctor	1.800	Bellows Falls	2,100
Wallingford	1.700	Brattleboro	1,500
Williamstown	1,500	Burlington	3,100
Chester	1,600	Derby	1,600
West Charleston	1 500	Montpelier	2,800
Lunenburg	1.500	Rutland	2.400
East Barnet	1.550	St. Albans	2.100
Cabot	1.500	St. Johnsbury	2.400
Alburg	1,500	Springfield	1.900
Bradford	1,500	White River Junction	1.900
Craftsbury	1,650	South Barre	1.700
Hyde Park	1,500		
Canaan	1,550	Average for 12 cities	2.133
Waterbury	1,500		
Ludlow	1,550		
Brandon	1,500		
Middlebury	1,800		
Shoreham	1,650		
Rochester	1,500		
Barton	1,550		
Vergennes	1.500		
Richford	1,600		
Newport	1,800		
East Fairfield	1,550		
Burlington R. D. No. 1	1,500		
Essex Junction	1,500		
Fair Haven	1,800		
Morrisville	1,800		
Swanton	1,550		
Northfield	1.600		
West Burke	1,500		
Plainfield	1.500		
Lyndon Center	1.500		
Castleton	1.800		
West Pawlet	1,500		
Londonderry	1.500		
North Troy	1.800		
South Strafford	1,500		
West Brattleboro	1,500		
Randolph	1,600		
Woodstock	1.500		
Richmond	1,500		
Readsboro	1,700		
Wells River	1.500		
Windsor	1.500		
Putney	1.500		
South Royalton	1.600		
Milton	1.500		
Bennington	1.800		
Enosburg Falls	1,750		
Townshend	1,500		
South Shaftsbury	1.800		
Cambridge	1.700		
Average for 54 Union districts	1,586		

VIRGINIA.

County.	Superintendent.	City.	Superintendent.
Accomac	$2,005	Alexandria	$1,200
Albemarle	1,350	Bedford City	1,200
Alexandria	1,800	Big Stone Gap	1,350
Alleghany	1,518	Bristol	2,000
Amelia and Nottaway	1,895	Charlottesville	1,650
Amherst	1,025	Covington	2,000
Appomattox	660	Danville	2,124
Augusta	1,600	Farmville	1,600
Bath and Highland	1,302	Lynchburg	3,000
Bedford	1,200	Lexington	1,800
Bland	460	Newport News	1,600

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[1] Towns given here are the resident towns of the district superintendents. The 54 union district superintendents have 242 towns under their supervision.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

VIRGINIA—Continued.

County.	Superintendent.
Botetourt	1,125
Brunswick	1,525
Buchanan	1,325
Buckingham	1,025
Campbell	1,200
Caroline	900
Carroll	1,100
Charles City, James City, and New Kent	1,225
Charlotte	1,230
Chesterfield	1,500
Clarke	320
Craig	231
Culpeper	957
Cumberland and Goochland	1,800
Dickenson	1,023
Dinwiddie	1,325
Elizabeth City	1,250
Essex and King and Queen	1,210
Fairfax	1,850
Fauquier	2,000
Floyd	900
Fluvanna	900
Franklin	900
Frederick	1,000
Giles	780
Gloucester	815
Grayson	853
Greene and Madison	1,632
Greenesville	1,711
Halifax	1,600
Hanover	900
Henrico	2,000
Henry	1,100
Isle of Wight	1,400
King George	390
King William	800
Lancaster and Northumberland	1,890
Lee	1,281
Loudoun	1,400
Louisa	978
Lunenburg	1,225
Mathews and Middlesex	885
Mecklenburg	1,375
Montgomery	1,000
Nansemond	1,956
Nelson	925
Norfolk	3,105
Northampton	1,200
Orange	1,200
Page and Rappahannock	1,940
Patrick	1,045
Pittsylvania	1,500
Powhatan	280
Prince Edward	1,025
Prince George and Sussex	2,620
Princess Anne	1,070
Prince William	1,154
Pulaski	1,512
Richmond and Westmoreland	1,210
Roanoke	1,332
Rockbridge	916
Rockingham	1,500
Russell	1,216
Scott	1,550
Shenandoah	1,100
Smyth	1,600
Southampton	1,778
Spotsylvania and Stafford	1,020
Surry	1,280
Tazewell	1,250
Warren	720
Warwick and York	1,120
Washington	1,615
Wise	2,511
Wythe	1,200
Average for 86 county divisions	1,290

City.	Superintendent.
Norfolk	$3,200
Petersburg	2,500
Portsmouth	2,000
Pulaski	1,500
Richmond	[1] 5,000
Roanoke	2,500
Salem	1,485
Staunton	2,000
Wytheville	1,200
Average for 20 cities	2,155

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[1] One assistant at $3250, and one at $2,700.

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

WASHINGTON.

County.	Superintendent.	City.	Superintendent.
Adams	$1,100	Aberdeen	$2.250
Asotin	750	Anacortes	2,100
Benton	750	Bellingham	3,200
Chehalis	2,000	Bremerton	[2] 1,600
Chelan	1,200	Centralia	2,100
Clallam	750	Chehalis	[1] 2,100
Clarke	1,200	Clarkston	1,800
Columbia	700	Cle Elum	[2] 1,800
Cowlitz	1,200	Colfax	2,400
Douglas	1,000	Ellensburg	1,200
Ferry	600	Everett	4,250
Franklin	700	Hillyard	1,500
Garfield	600	Hoquiam	2,400
Grant	1,000	North Yakima	2,700
Grays Harbor	700	Olympia	2,400
Island	600	Port Townsend	[2] 1,700
Jefferson	1,000	Pullman	2,000
King	2,000	Puyallup	2,000
Kitsap	1,200	Renton	1,800
Kittitas	1,200	Roslyn	1,860
Klickitat	1,100	Seattle	[3] 7,500
Lewis	1,200	Snohomish	2,000
Lincoln	1,200	South Bend	1,800
Mason	700	Spokane	4,800
Okanogan	1,200	Tacoma	[4] 5,000
Pacific	1,200	Vancouver	2,160
Pend Oreille	750	Walla Walla	3,300
Pierce	2,000	Wenatchee	1,800
San Juan	500		
Skagit	1,200	Average for 28 cities	2,551
Skamania	400		
Snohomish	1,800		
Spokane	2,000		
Stevens	1,200		
Thurston	1,200		
Wahkiakum	500		
Walla Walla	1,200		
Whatcom	1,800		
Whitman	2,000		
Yakima	2,000		
Average for 40 counties	1,117		

WEST VIRGINIA.

County.	Superintendent.	City.	Superintendent.	Assistant.
Barbour	$955	Benwood	$1,400	$1,000
Berkeley	973	Bluefield	2,500	....
Booone	925	Buckhannon	1,500	....
Braxton	1,075	Cameron	1,600	....
Brooke	850	Charleston	3,300	....
Cabell	1,365	Charles Town	1,500	....
Calhoun	850	Chester	1,450	....
Clay	850	Clarksburg	2,800	....
Doddridge	943	Davis	1,350	....
Fayette	1,500	Elkins	2,000	....
Gilmer	925	Fairmont	2,600	....
Grant	850	Grafton	2,000	....
Greenbrier	1,221	Hinton	1,500	....
Hampshire	925	Huntington	3,000	....
Hancock	850	Keyser	1,500	1,200
Hardy	925	McMechen	1,000	....
Harrison	1,500	Mannington	1,800	....
Jackson	1,067	Martinsburg	1,650	....
Jefferson	850	Morgantown	2,200	....
Kanawha	1,500	Moundsville	1,600	....
Lewis	1,055	Parkersburg	3,000	....
Lincoln	985	Princeton	1,600	1,035
Logan	1,035	Richwood	1,500	....
Marion	1,441	Sistersville	1,600	1,200
Marshall	1,155	Wellsburg	1,800	....
Mason	1,049	Wheeling	3,000	....
Mercer	1,323	Williamson	1,750	....
Mineral	947			
Mingo	1,027	Average for 27 cities	1,944	....
Monongalia	1,139			

[1] One assistant at $1,500.

[2] One assistant at $1,200.

[3] One assistant at $3,600 and one at $2,700.

[4] One assistant at $2,300.

Table 6.—*Salaries of county and city superintendents of schools*—Continued.

WEST VIRGINIA—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Monroe	$957			
Morgan	775			
McDowell	1,327			
Nicholas	1,029			
Ohio	925			
Pendleton	925			
Pleasants	775			
Pocahontas	975			
Preston	1,201			
Putnam	993			
Raleigh	1,195			
Randolph	1,139			
Ritchie	1,155			
Roane	1,049			
Summers	1,037			
Taylor	937			
Tucker	951			
Tyler	983			
Upshur	997			
Wayne	1,105			
Webster	925			
Wetzel	1,143			
Wirt	925			
Wood	1,273			
Wyoming	935			
Average for 54 counties	1,052			

WISCONSIN.

County.	Superintendent.	City.	Superintendent.	Assistant.
Adams	$1,000	Antigo	$2,000	....
Ashland	1,800	Appleton	1,200	....
Barron	1,100	Ashland	1,900	....
Bayfield	1,200	Baraboo	2,200	....
Brown	1,500	Beaver Dam	2,100	....
Buffalo	1,000	Beloit	2,700	....
Burnett	1,000	Berlin	1,800	$855
Calumet	1,100	Burlington	2,000	....
Chippewa	1,000	Chippewa Falls	2,500	....
Clark	1,200	Columbus	1,900	....
Columbia	1,350	Cudahy	1,650	....
Crawford	1,200	De Pere	1,300	....
Dane:		Eau Claire	2,600	....
First district	1,500	Edgerton	2,700	900
Second district	1,600	Fond du Lac	2,800	....
Dodge	1,400	Fort Atkinson	2,000	....
Door	1,200	Grand Rapids	2,500	....
Douglas	1,200	Green Bay	2,500	1,850
Dunn	1,200	Hartford	2,000	....
Eau Claire	1,000	Hudson	1,900	1,200
Florence	1,000	Janesville	2,500	....
Fond du Lac	1,200	Jefferson	2,100	....
Forest	1,200	Kaukauna	2,100	....
Grant	1,500	Kenosha	2,600	....
Green	1,200	La Crosse	3,000	....
Green Lake	....	Lake Geneva	1,850	1,000
Iowa	1,100	Madison	2,700	1,800
Iron	1,000	Manitowoc	3,000	....
Jackson	1,000	Marinette	3,000	....
Jefferson	1,200	Marshfield	2,200	1,200
Juneau	1,200	Menosha	2,600	....
Kenosha	1,200	Menomonie	2,100	1,050
Kewaunee	1,200	Merrill	1,400	....
La Crosse	1,300	Milwaukee	7,500	4,200
La Fayette	1,200	Mineral Point	1,800	....
Langlade	1,500	Monroe	2,000	....
Lincoln	1,200	Neenah	2,500	....
Manitowoc	1,500	New London	1,400	....
Marathon	1,600	Oconomowoc	1,700	800
Marinette	1,200	Oconto	2,000	....
Marquette	1,200	Oshkosh	3,000	....
Milwaukee	2,500	Platteville	2,000	....
Monroe	1,200	Plymouth	2,000	1,400
		Portage	2,100	....
Oconto	1,350	Port Washington	1,600	....
Oneida	1,200	Prairie du Chien	1,800	900
Outagamie	1,200	Racine	3,200	....

TABLE 6.—*Salaries of county and city superintendents of schools*—Continued.

WISCONSIN—Continued.

County.	Superintendent.	City.	Superintendent.	Assistant.
Ozaukee	$1,000	Reedsburg	$2,000	....
Pepin	1,006	Rhinelander	2,400	....
Pierce	1,000	Rice Lake	2,000	....
Polk	1,200	Richland Center	1,800	....
Portage	1,000	Ripon	1,700	....
Price	1,000	Shawano	1,500	$900
Racine	1,200	Sheboygan	2,600	950
Richland	1,200	South Milwaukee	2,050	1,150
Rock	1,800	Sparta	2,100	....
Rusk	1,100	Stanley	1,700	810
St. Croix	1,300	Stevens Point	2,000	....
Sauk	1,500	Stoughton	2,500	....
Sawyer	1,000	Sturgeon Bay	1,700	800
Shawano	1,300	Superior	3,000	....
Sheboygan	1,200	Tomah	2,000	....
Taylor	1,400	Tomahawk	1,650	....
Trempealeau	1,100	Two Rivers	2,500	....
Vernon	1,200	Washburn	1,500	....
Vilas	1,200	Watertown	2,250	....
Walworth	1,200	Waukesha	2,500	1,100
Washburn	1,200	Waupaca	1,800	....
Washington	1,400	Waupun	1,600	1,000
Waukesha	1,400	Wausau	3,000	1,200
Waupaca	1,500	Wauwatosa	2,500	....
Waushara	1,000	West Allis	2,400	....
Winnebago	1,500	Whitewater	2,000	1,000
Wood	1,400			
Average for 71 counties	1,254	Average for 73 cities	2,229	....

WYOMING.

Albany	$900	Casper	$2,200	....
Big Horn	750	Cheyenne	2,800	....
Campbell	500	Evanston	1,900	....
Carbon	900	Laramie	2,400	....
Converse	750	Rawlins	2,000	....
Crook	500	Rock Springs	2,400	....
Fremont	750	Sheridan	3,000	....
Goshen	500			
Hot Springs	500	Average for 7 cities	2,371	....
Johnson	500			
Laramie	900			
Lincoln	900			
Natrona	900			
Niobrara	500			
Park	750			
Platte	750			
Sheridan	900			
Sweetwater	900			
Uinta	750			
Washakie	750			
Weston	500			
Average for 21 counties	717			

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